Photo. by H. F. Macmillan.

VIEW ACROSS THE GREAT LAWN, ROYAL BOTANIC GARDENS, PERADENIYA.

THE
TROPICAL AGRICULTURIST:
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AGRICULTURAL EDUCATION.

The opening of the School of Tropical Agriculture which takes place this month is an occasion that may be looked back upon in time to come as an important milestone in the progress of tropical agriculture in the East. The opportunity should not therefore be allowed to pass without recalling the names of members of the Board of Agriculture and others whose labours have contributed to the ultimate establishment of the school. It was DR. WILLIS, Director of the Royal Botanic Gardens, who first suggested the school should be at Peradeniya; or rather "in the neighbourhood of Kandy" in order to be near the Experiment "Garden" (now the Experiment Station) which it was hoped to open at Peradeniya. MR. JOHN FERGUSON, a member of the Commission appointed by SIR WEST RIDGEWAY in 1900 to consider the question of establishing a Department of Agriculture, supported DR. WILLIS's suggestion, which was subsequently approved by the Government. In 1909 MR. JOHN FERGUSON read a paper on Agricultural Education for which he was personally thanked by the Governor, SIR HENRY MCCALLUM. Other papers and memoranda on the subject were contributed by MR. JOHN HARWARD, Director of Education, DR. WILLIS, DR. LOCK, MR. E. EVANS and MR. W. A. de SILVA. Another prominent member of the Board, DR. H. M. FERNANDO, was on the committee appointed by the GOVERNOR in 1909 to consider and report upon proposals for establishing agricultural training in Ceylon. There has however been one member more conspicuously identified with Agricultural Education than

anyone else in or out of the Society, namely MR. C. DRIEBERG, the Secretary, and Assistant Editor of this Journal, who is the Vice-Principal of the new school. MR. DRIEBERG was head of the Agricultural School in Colombo which was closed in 1901 when the Peradeniya scheme took shape. To that school we trace the germ of the present one and it must be particularly gratifying to MR. DRIEBERG to witness after 15 years his labours bearing renewed fruit.

One soweth and another reapeth. Our late Governor, SIR ROBERT CHALMERS, who left our shores last month, brought to a head the project of his predecessors by directing that plans for the school should be prepared and its establishment proceeded with. This has been done in a time of war and retrenchment and consequently in the most economical way possible. For the accommodation of boarders, 30 in number, an empty bungalow belonging to the Government has been occupied for one hostel and another bungalow has been leased for a second. A temporary building 58 feet by 20 feet has been erected in the Royal Botanic Gardens for the principal class-room. There is a smaller building for a second class-room. Furniture for the hostels and class-rooms has been made by prison labour from wood supplied by the Forest Department. No excessive outlay has therefore been incurred on buildings and equipment. Expenditure connected with the teaching staff will be met to some extent by tuition fees of the students.

Our circumstances are upretentious, our equipment inexpensive, befitting the time and the future about which we have no delusions. The school at present is popular but this popularity may perhaps wane if ex-students are disappointed in their expectations of obtaining immediate employment afterwards. Some years must elapse before the true place of the school in the economic welfare of the island is clearly understood and appreciated. But that this will eventually take place we have no misgivings whatever. Providing some professional equipment for young men destined for the land is, however, only part of the objects of the School. Teachers for the Government vernacular schools are to take the course in order to qualify them for teaching agri-

culture. At first only six are attending but this number will probably be increased annually till all who pass through the Training College will be sent to Peradeniya before being drafted out to the villages. Agriculture we hope may then become one of the subjects of the code. Boys whose lives are to be spent on the land, the lot of the vast majority, will then be taught something of their mother earth and her products which are their living, beyond what they are able to learn by uneducated observation. When, as will happen in the course of time, the 1,600 or 1,700 teachers on the staff of the Government village schools will all have been to Peradeniya we shall have created automatically, in conjunction with the School Gardens already established, an organization for enabling the problems of village agriculture largely to solve themselves. Of course all teachers will not become competent agriculturists; there will always be some for whom rural pursuits possess no attractions. On the other hand there will be many who, having had their interests aroused, will follow up their studies and become for their people enthusiastic leaders along more enlightened paths. It will be seen what great possibilities this system of agricultural education possesses for Ceylon.

In another direction the School may be expected to operate for good. One of our problems at Peradeniya is to make known to and understood by the people the results of our work. Take for example the new system of water control to paddy fields now under trial at the Experiment Station. Paddy cultivators, for whom this might mean much, will remain—as to the majority of them—ignorant of these methods and of their results because they do not read our publications nor will they—or indeed can they—come and look at the crop growing and see for themselves. Students spending a year or more at Peradeniya will take away with them when they leave first-hand knowledge of the work of the Department, which will thus become linked up with all parts of the country. They will be acquainted with the activities of Peradeniya and with its personnel whom they will have come to regard not only as instructors but also we may hope as friends and advisers. This process of familiarizing the Department in all quarters of the island will have a reciprocal effect upon the Department itself by enabling it in an ever increasing degree to get into closer touch both with the planter and village cultivator and their needs.

R. N. L.

THE HOME OF THE SCHOOL OF TROPICAL AGRICULTURE.

A HISTORICAL SKETCH OF THE ROYAL BOTANIC GARDENS, PERADENIYA.

[*Illustrated—See frontispiece.*]

The history, as well as the reputation, of the Royal Botanic Gardens, Peradeniya, is fairly well known, but in view of another prominent milestone in its career being reached, namely, the School of Tropical Agriculture, a brief retrospective may not be uninteresting.

BOTANICAL ATTRACTIONS OF CEYLON.

Ceylon has long been regarded as an attractive and promising field for the botanist, no less so than for the enterprising planter, and early botanical expeditions from Europe may be traced back to the middle of the seventeenth century. About that period the Dutch East India Company engaged a MR. HERMANN, a well-known scientist of his time, to describe the plants and spices growing in the Island—a task beset with many difficulties in view of the fact that the interior was then practically impenetrable to Europeans. Nevertheless HERMANN succeeded in making an important herbarium collection comprising some 600 species. This nucleus, it may be mentioned, is now in the British Museum, London. HERMANN was followed at varying intervals by other distinguished botanists—BURMAN, THUNBERG, and KŒNIG, (names commemorated in well-known genera and species of plants) to mention only a few.

THE BEGINNING OF THE ROYAL BOTANIC GARDENS.

Soon after the arrival of the British in 1796, the importance of a properly established botanic garden, both for the study of the indigenous flora and for the introduction and acclimatisation of useful foreign plants, was recognised. In 1799 a site was chosen at Peliyagoda, afterwards found unsuitable; in 1810 another site was selected at Slave Island, and placed under the superintendence of MR. KERR, a trained horticulturist from Kew. He named it Kew, a name still in use in that locality. This, however, was not destined to be the "Kew of the East," though no doubt the commencement made there helped, when the stock was transferred to Peradeniya, to make the latter place worthy of this appellation. KERR secured the honourable title of "Royal Botanic Gardens" for his department, but the site of Colombo as well as one of 600 acres procured later at Kalutara proved unsuitable for its purpose.

DISCOVERY OF PERADENIYA BY MOON.

The honour of discovering Peradeniya was due to ALEXANDER MOON, who succeeded KERR in 1816. MOON was a zealous botanist and did much to enhance the knowledge of Ceylon botany. He published in 1824 his "Catalogue of Ceylon Plants," a volume containing a record of over 900 indigenous and a number of exotic plants.

EARLY BOTANIC PUBLICATIONS.

This book is of special interest as being the first publication giving specific names to Ceylon plants in accordance with the binomial system of

Photos by H. F. Macmillan.

ENTRANCE TO THE ROYAL BOTANIC GARDENS, PERADENIYA.

MAIN CENTRAL DRIVE, ROYAL BOTANIC GARDENS, PERADENIYA.

nomenclature invented by LINNÆUS. MOON was an indefatigable botanical collector, and the magnitude of his collections may be estimated from the fact that it took ten carts to remove them to Peradeniya, the journey doubtless occupying many days. It was in 1821 that MOON selected at Peradeniya the site, and formed the nucleus, of what was destined to become a botanical institution of world-renowned fame. MOON, like his predecessor, succumbed to fever, after an energetic career of nine years. His name has been commemorated in the genus *Moonia* (now *Chrysogonum*), whilst KERR's memory has been preserved by the well-known Japanese shrub *Kerria*.

PROGRESS OF BOTANICAL WORK.

Peradeniya henceforth became the centre of botanical activity, but in subsequent years it passed through many vicissitudes, as might be expected in a country where there is necessarily a somewhat frequent change of officials. In the twenty years following MOON's period no less than seven superintendents succeeded to the charge, none of them leaving, as far as the Gardens were concerned, a record of conspicuous service, due perhaps to circumstances beyond their control. At one time the Gardens, or such portions as were then under cultivation, were used as a market garden, the produce being sold in Kandy.

ARRIVAL OF DR. GARDNER, F.L.S.

In 1844 the Department may be said to have entered upon a new era of activity by the arrival of GARDNER. GARDNER was an enthusiastic traveller and collector, and already famous by his explorations in Brazil. His activity may be judged from the fact that he collected and dried about a thousand species when on a health trip to the Nilgiris. With but few facilities he travelled over a large portion of Ceylon, but his strenuous career was cut short by his untimely death at Nuwara Eliya, four years after his arrival in the Island. His name has been honoured in the genus *Gardneri* and in several species. This made the eighth superintendent in 24 years.

DR. THWAITES, F.R.S.

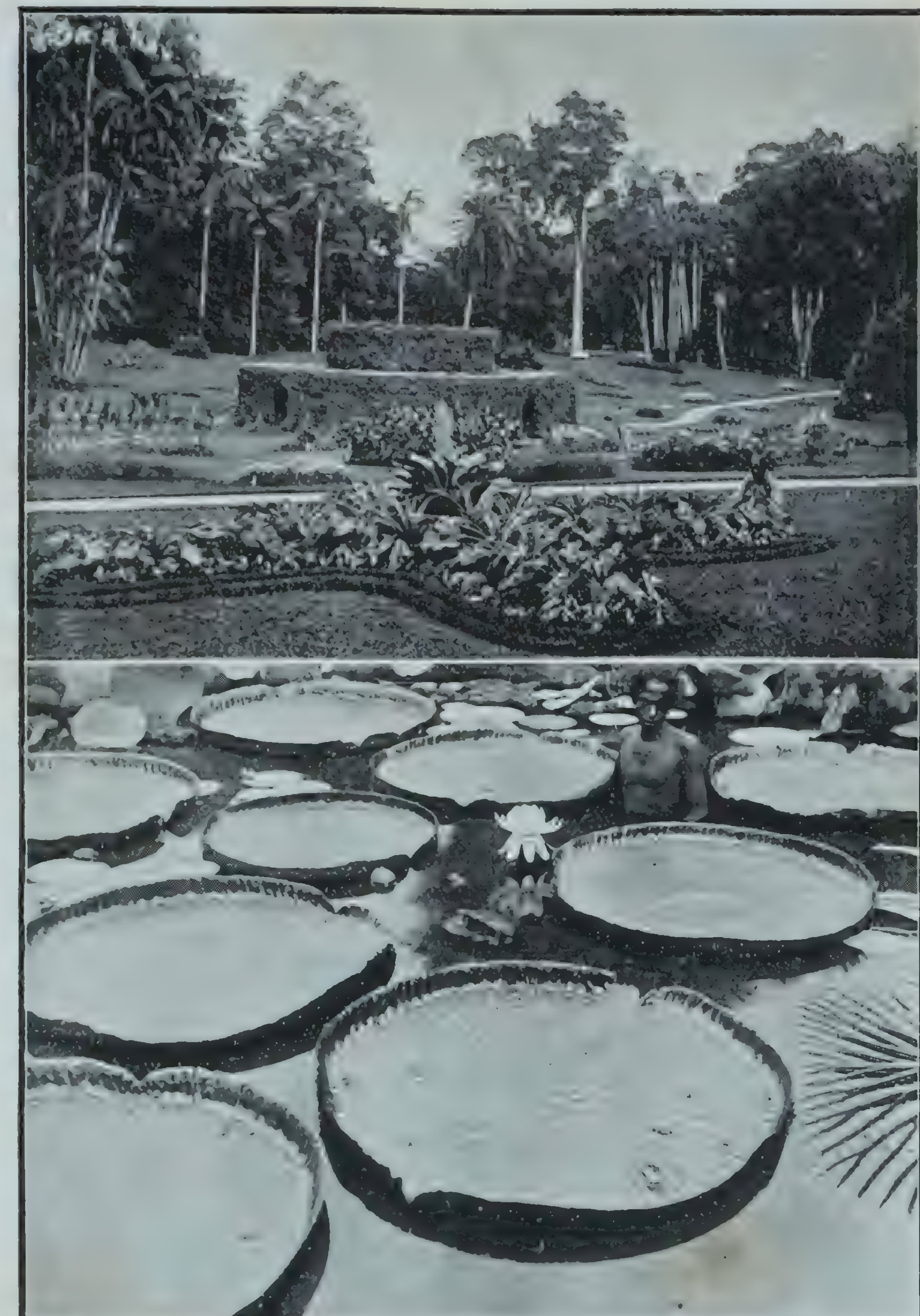
Succeeding GARDNER, Dr. THWAITES arrived early in 1850 to take up the duties of the post, which he worthily and uninterruptedly held for over 30 years, during which he never left the Island. THWAITES was an indefatigable worker and a distinguished botanist. He published among other works his ENUMERATIO PLANTARUM ZEYLANIÆ, a work entirely in Latin and rigidly technical. It was during his tenure that the branch garden at Hakgala was opened (1860), and that at Henaratgoda in 1876, the former for experimenting with Cinchona and other products suited to the higher elevations, and the latter (Henaratgoda) in the low-country for the first introduction of Hevea rubber in the East and for the experimental cultivation of low-country products. In 1868 the 2-storeyed building for the herbarium and library was opened, these being hitherto kept in a portion of the Director's bungalow—now the head offices. The designation of the post was altered in 1857 from Superintendent to Director. The algal genus *Thwaitesia* and the beautiful flowering epiphytic shrub *Kendrickia* were dedicated to THWAITES by his botanical friends in Europe. DR. THWAITES died in Kandy in 1882, and a cenotaph memorial was erected to his memory in 1885, in a prominent part of Peradeniya Gardens.

DR. TRIMEN, F.R.S.

DR. TRIMEN succeeded THWAITES in 1880, at a time of depression in the Colony owing to the coffee leaf disease, which finally resulted in the extermination of the coffee industry. It is undoubtedly to TRIMEN more than any one else that the present advanced state of knowledge of the Ceylon flora is due. A distinguished scientist and a man with a marvellous capacity for work, he was also a keen horticulturist. In contrast to his predecessors he devoted much energy to carrying out improvements in the Gardens, where he was wont to spend his early mornings and evenings designing improvements and making a personal study of the collections. He introduced new systems and new features, including the general labelling of trees, shrubs, &c., which practice, curiously enough, did not find favour with his predecessor. The opening up of the southern end of the Gardens, the commencement of the Students' Garden, and the Talipot avenue are among the features initiated by TRIMEN. He started the Museum at Peradeniya, opened a branch-garden at Anuradhapura in 1883, and another at Badulla in 1886, both of which he personally laid out. A facile and prolific writer, he was author of several important publications. He was for some time Editor of the JOURNAL OF BOTANY, to which and to similar publications he was a frequent and regular contributor. He had contributed no less than 50 papers to the Royal Society, of which he was a Fellow. He was a recognised authority on quinology, co-author of a standard work on MEDICAL PLANTS, author of FLOWERING PLANTS AND FERNS INDIGENOUS TO CEYLON, and HORTUS ZEYLANICUS. His *magnum opus*, however, was his FLORA OF CEYLON, a standard work and, according to SIR JOSEPH HOOKER, a model of what such compilations should be, it being "characterised by the critical insight and terse lucidity which always distinguished the author." DR. TRIMEN died in harness, in 1896, after only 15 years' service and a trying illness, his tragic death-bed being literally covered with manuscripts. It is regretted that no memorial has as yet been erected to his memory in the Gardens, which he loved so intensely and did so much to develop on utilitarian and scientific lines.

DR. WILLIS, F.L.S.

Following TRIMEN in 1896, DR. J. C. WILLIS took up the duties of Director with energy, and at a time when rubber was talked about as a likely product for the low-country. He succeeded in considerably increasing the staff of expert officers of the Department, securing the appointment of a mycologist, entomologist, scientific assistant (afterwards superseded by the post of assistant-director), two superintendents of experiment stations and a Government chemist. Gangoruwa estate was acquired in 1902 as an experiment station, and WILLIS foreshadowed its use for the training of students in tropical agriculture. In the same year an experiment garden was opened at Nuwara Eliya, and in 1904 a cotton experiment station at Mahailuppalama at the instance of the British Cotton Growing Association. The useful branch gardens at Badulla and Anuradhapura established by TRIMEN were, however, abolished. The School Gardens, under the superintendence of MR. C. DRIEBERG, were combined with the Department in 1901. The Ceylon Agricultural Society was inaugurated in 1904, with DR. WILLIS *exofficio* as Organising Vice-President. The Research laboratory was completed in 1900, and the new 2-storied building for the Botanical Museum and Herbarium in 1908.



Photos by H. F. Macmillan.

The top photograph shows a view in the Floriculture Section, with the Octagon Conservatory in the centre; the lower shows a good specimen of the Giant Water Lily (*Victoria regia*).

IN THE ROYAL BOTANIC GARDENS, PERADENIYA.

WILLIS published his useful book DICTIONARY OF FLOWERING PLANTS AND FERNS before coming to Ceylon, and while in office he brought out a general guide book to the Island and a book on tropical agriculture. His principal work was his monograph of the *Podostemmaceæ*, published in 1902. WILLIS began the publication of the Annals of the Royal Botanic Gardens in 1901, also the Circulars (now Bulletins) of the Department. In 1905 he met with an unfortunate accident whilst on circuit in the N.C. Province. He resigned in 1911, the post of Director of the Royal Botanic Gardens having been abolished, and afterwards went as Director of the Botanic Gardens, Rio de Janeiro, from which he retired in 1915.

MR. R. N. LYNE, F.L.S.

This is not the time to give MR. LYNE's biography, but it is essential for the purpose of this sketch to refer to his name in chronological order, as he is the first Director of Agriculture in Ceylon. A change to a more utilitarian policy for the Department had been decided upon by Government, as a result of prolonged deliberation inaugurated by SIR WEST RIDGEWAY in 1900, continued by SIR HENRY BLAKE, who founded the Ceylon Agricultural Society with a view to the better development of agriculture, and brought to a head by SIR HENRY McCALLUM. As a result a Department of Agriculture was formed, and MR. LYNE was selected for the new post in 1912, arriving from Portuguese East Africa, where he relinquished a similar charge. He held previously the office of Director of Agriculture in Zanzibar, and was the author of two books on both these spheres of his former labours.

The reorganisation and expansion of the Royal Botanic Gardens Department into a Department of Agriculture was completed in 1913 by the formation of seven separate Divisions, each under a responsible and experienced chief with a considerable scope and freedom for independent action. These Divisions are: Mycology and Botany, Entomology, Botanic Gardens, Chemistry and Rubber Research, Experiment Stations, Low Country Products and School Gardens, and Agricultural Education. The result of this arrangement was definitely to apportion responsibility and to relieve the Director of much routine work. The re-organisation of his Department completed, LYNE proceeded to establish Trial grounds at Anuradhapura for dry zone crops and at Jaffna for tobacco, the latter under the management of an expert tobacco planter from America. Manurial experiment plots of coconuts were instituted at Chilaw, Negombo and other parts of the Island. The administration of the Co-operative Credit Societies Ordinance was transferred to the Department of Agriculture in 1913, MR. LYNE being appointed Registrar. In the same year the TROPICAL AGRICULTURIST, edited by LYNE, was purchased from MESSRS. A. M. & J. FERGUSON and became the property of the Ceylon Agricultural Society as its journal, the headquarters of the Society having been transferred to the Royal Botanic Gardens in the meantime. The publication of the Department, hitherto known as "circulars" became in 1912 *bulletins*. In 1913 the proposal for a College of Tropical Agriculture being established in Ceylon received concrete shape, and we may hope that the new school now inaugurated is a step in the direction of the ultimate establishment of this important project.

LANDSCAPE DEVELOPMENT.

Returning to the history more particularly of the Gardens, it is necessary to allude to the writer who was appointed from Kew as Curator in 1895.

From this date the development of the great natural advantages of the site of the Gardens received special attention, and it is proposed now to refer to some of the prominent changes that have been effected during that period.

THE MAIN CENTRAL DRIVE.

The Central Drive, now one of the features of Peradeniya, was then but a narrow track bordered by strips of struggling turf under the shade of overhanging trees. This was first taken in hand. Superfluous trees and all the shrubs, etc., along the front were removed in order to obtain a greater and more commanding width. The borders throughout their length were replanted with due regard to variety and quality of the plants employed, and the whole drive remade and levelled. The drive is now known as the glory of Peradeniya. (See illustration).

THE FERNERY.

Afterwards the Fernery was taken in hand, being re-constructed and considerably extended. By getting rid of some enormous specimens of Ficus and Canarium trees a commanding view (see illustration) has been gained from the Central Drive.

FLORICULTURE SECTION.

At that time the chief beauty of the Gardens consisted largely in their wildness. There was no attempt at floriculture except a few small beds round the plant-houses. Now there is an extensive and beautifully undulated Floricultural Section in a central part, which was formerly purposelessly occupied by a growth of common vegetation, decaying tree stumps and stone boulders. This has been converted into the most popular and most frequented part of the Gardens and has, it is believed, no rival in any botanic garden in the tropics, the plants used being nearly all selected tropical kinds grown in masses (see illustration). Breaks were made in the borders of the Central Drive in order to obtain glimpses of this new feature on one side, and of the extensive lawn on the other. The Great-lawn, which had been made chiefly by TRIMEN, was far from complete; several unsightly old trees had to be removed, irregularities reduced and the surface generally brought to the state of a lawn (see frontispiece).

THE ARBORETUM.

The work of improving the Arboretum, which was then mostly in a state of unbridled nature, was a long process and has only recently (1914) been brought to anything like completion by MR. T. H. PARSONS, who was appointed Curator on the promotion of the writer to Superintendent of the Division of Botanic Gardens in 1912. Twenty years ago it was difficult to find one's way about in, much less become properly acquainted with, the contents of this interesting and essential part of the Gardens. The most common trees were *Michelia*, *Cananga*, *Bombax* and wild varieties of Mango. Coconuts and arecanuts were numerously interspersed, many of them having the appearance of being self-sown. The task of cutting out the excessive vegetation, while retaining uninjured the desirable species, and of removing the unsightly and enormous tree stumps, was only satisfactorily accomplished after several years, the rule of cutting trees low down not having previously been enforced. The two vistas here, commanding peeps of distant hills, were first opened out in 1898 and re-opened and enlarged in 1914.

Photos by H. F. Macmillan.

TALIPOT PALM AVENUE (*Corypha umbraculifera.*)

THE ROYAL PALM AVENUE. (*Oreodoxa regia.*)

IN THE ROYAL BOTANIC GARDENS, PERADENIYA.

THE LAKE.

In 1904 what was formerly a deep pond, unfit for ornamental or useful purpose, was converted into a little lake by sloping away the banks and making a cutting round a group of trees and bamboos which thus at once formed a ready-made island; the earth obtained served for filling in the lake to a reasonable depth, rendering it fit for the growth of water plants, including the Giant Water-lily of Brazil and the Papyrus of the Nile, both recent introductions.

AVENUES AND THE GREAT CIRCLE.

The fine avenue of *Oreodoxia regia* (see illustration) was planted in 1898 and the road through it made in the following year. The *Brownea* avenue was planted in 1900 and interplanted with *Cassia multijuga* in 1904. An avenue of the beautiful *Lagerstrœmia* was planted in 1910 to separate the floricultural section from the fruit collection. The new row of Talipot palms, commencing near the orchid-house, was planted in 1907, while the Amherstia row flanking the approach to the Gardens on the Kandy side and the new Ficus row on the opposite side were planted in 1904 and 1914 respectively. What promises to become a unique avenue of the Double coconut palm, or Coco-de-mer *(Lodoicea Sechellarum)* was begun along the monument road in 1902, the nuts, obtained from Seychelles, being sown *in situ*. In 1906, after the first Rubber Exhibition was held on the Great Circle in the Gardens, a sum of Rs. 1,100 was used on levelling and improving that spacious lawn. The Spice Collection was begun in 1897 and considerably extended in 1914 by the levelling of the deep elephant ditch which formerly formed the Gardens boundary to the East. An illustrated guide book to the Gardens was published in 1905.

H. F. MACMILLAN.

PALM KERNEL CAKE AND HOME FARMING.

Rising prices of meat and milk, to which we are becoming painfully accustomed, reflect the difficulties of the farmer in obtaining fodder and feeding stuffs for his stock. The vagaries of the past season's harvests have thrown the dairy farmer and breeder more than ever back on supplementary and concentrated feeding stuffs to tide them over the winter months. For some years the greater available variety of ingredients for cakes and meals has steadied their prices to the farming community. Soya beans, for instance, have been a great boon, and a similar good turn is now being done by the greater supply of palm kernel cake being put on the market. The cakes, made from the milling refuse of palm kernels from West Africa, are steadily being produced more and more at home. As was recently pointed out in our columns, the bulk of the palm kernel trade was in German hands till war broke out. Energetic measures have since been taken to secure the rapid diversion of the trade into British hands as a permanent asset. The great increase in the importation to the Home Country has been of much assistance to soap-makers and other industries using the the fatty oils, and has rendered timely aid to the farmer in his endeavours to meet the home demand for more meat and milk during the coming months. Tests made at the agricultural colleges on fattening by decorticated cotton cake, by linseed cake, and by palm kernel cake, show that the last named (taking into account manurial values) yields the best monetary return. It contains a very heavy percentage of oil and can be easily stored. Altogether there is promise of very valuable results from the new enterprise, which has the advantages of employing home labour, improving agricultural returns, and extending Imperial reserves of a useful agricultural and industrial product.—United Empire.

RUBBER.

RELATION OF RAINFALL TO CROPS.

The Statistical Committee of the Rubber Growers' Association (Incorporated) forwards charts* and statements showing the percentages of crops harvested, and of rainfall recorded, monthly in 1913 and 1914, by a representative number of rubber estates in Ceylon and Malaya. The figures are computed on annual crops of from seventeen to twenty million pounds of rubber in the Malaya chart, and from five to seven million pounds of rubber in the Ceylon chart. The investigation was undertaken at the suggestion of Mr. H. K. RUTHERFORD, and that gentleman and other Members of Council and of the Association were instrumental in obtaining the data from which the charts and tables have been prepared.

It will be noticed from the tables, which we print as received, that there is not great variation in crop percentages between 1913 and 1914 in either country.

The charts show that the wintering period, which occurs in February and March, coincident with the lowest rainfall, has a much greater effect on the crop of rubber in Ceylon than is the case in Malaya, but the figures are no doubt affected by the practice on some estates in Ceylon of ceasing or reducing tapping operations during the wintering season. The variation in the daily distribution of rainfall in the respective countries and in the different districts must also be taken into account.

The heaviest yielding month in Ceylon produced more than four times the quantity of rubber harvested in the poorest month (13·30 per cent. in December, 2·91 per cent. in March, 1914), and the crop of the Ceylon estates for the first six months of 1914 was only 36·26 per cent. of the total. In Malaya the fluctuations between the highest and lowest yielding months are much less pronounced (9·94 per cent. in December, 6·87 per cent. in March, 1914), whilst in the first six months of 1914 the Malaya estates harvested 45·49 per cent. of the total crop.

The Statistical Committee is asking company members to ascertain from their estate managers the approximate length of time rubber requires to dry each month, and to communicate the information. It would appear that machinery and drying space required should be less in Malaya, where monthly outputs do not show any extreme fluctuation, than in Ceylon, where as much as one-seventh of the year's crop is harvested in a single month.

It is the intention of the Committee to continue these charts from year to year, in order to see if the subsequent years conform the results shown by the present charts.

* Not reproduced.

CEYLON.

	1913. Crop.	1913. Rainfall.	1914. Crop.	1914. Rainfall.
January ...	6·68	10·21	8·09	2·66
February ...	4·76	3·63	5·38	1·95
March ...	3·23	2·97	2·91	6·97
April ...	5·54	8·64	5·82	7·60
May ...	6·49	9·46	7·35	10·80
June ...	7·82	5·82	6·71	16·74
July ...	8·76	6·44	8·96	5·09
August ...	9·71	4·91	9·15	5·05
September ..	9·42	5·10	9·40	9·89
October ...	10·46	20·55	10·38	16·73
November ...	13·50	10·94	12·55	8·85
December ...	13·63	11·33	13·30	7·67
	100·00	100·00	100·00	100·00

MALAYA.

	1913. Crop.	1913. Rainfall.	1914. Crop.	1914. Rainfall.
January ...	7·97	8·60	7·94	6·47
February ...	7·29	3·52	7·58	5·20
March ...	7·61	8·09	6·87	6·41
April ...	6·95	9·44	7·19	12·44
May ...	7·76	8·73	7·95	4·85
June ...	7·78	8·00	7·96	7·91
July ...	8·69	4·25	8·61	5·34
August ...	9·02	4·45	8·39	5·33
September ...	8·70	8·73	9·07	7·28
October ...	8·93	10·95	9·21	15·62
November ...	9·27	15·36	9·29	13·38
December ...	10·03	9·88	9·94	9·77
	100·00	100·00	100·00	100·00

—India Rubber Journal.

STANDARDISING RUBBER.

THE ILCKEN-DOWN PROCESS.

DEMONSTRATION IN MALACCA.

A demonstration of this latest process of preparing rubber for the market, which we described in detail recently, took place in the factory of Mr. Tan Chay Yan at Malacca on Saturday last, in the presence of several European and Chinese representatives from the neighbouring estates. The latex treated was from Mr. Tan Chay Yan's Bukit Lintang Estate, which was the first to

be planted with seedlings from the Singapore Botanic Gardens about 18 years ago. Both the patentees MESSRS. ILCKEN and DOWN were present, and whilst the former carried on the demonstration the latter explained and answered questions.

THE APPARATUS.

The apparatus consists of a circular zinc tank fitted with a cover and a stirrer. At the base of the tank an injector is fitted with 1/32 in. bore. To this injector is attached a length of rubber tubing connecting with a receptacle containing the precipitating mixture, solely composed of benzine and methylated spirit. The latex was measured and poured into the tank, and stirring was started. As soon as the latex thickened the mixture was gradually forced into the tank by a small foot pump, steady stirring being continued. The clot formed rapidly and after a short interval was removed from the tank and creped. The feel of the lump was much harder than we are accustomed to see with ordinary coagulation and it was noticed that the crepers found the coagulum very resistant.

It was announced that after testing the first shipments manufacturers have made strong enquiries and several estates have applied for licences to work under the patents. MR. TAN CHAY YAN also decided to try the process on his estate.—THE MALAYA TRIBUNE.

GINGER.

Ginger may be planted from August to November, or as late as December, putting the sets about one foot apart each way. The white varieties do better if planted twenty inches apart, and eight inches apart in the rows, the yellow requiring more space. When planting, the sets should be merely covered with soil, or better still, with old cow manure. The shoots will come above ground in twelve or fourteen days. The only cultivation needed is to keep the surface soil loose and clear, but not more than an inch of soil should be stirred. During the process the plants are all the better for a few shovels of rich, old compost added to the surface; the yield is in proportion to the richness of the soil. The roots are ripe in about seven months from the time of planting. The white sorts are the richest in flavour. The smaller, or narrow-leaved, variety is that used for the dry ginger of commerce. For this purpose the roots are allowed to lie in the ground until the leaf stalks have withered. They are then dug up and washed, the outside skin is scraped off, and the roots are dried in the sun.

PRESERVED GINGER.

To make preserves, the roots are dug as soon as they are fully grown and before the leaves begin to wither; they are then washed and scraped, cut into slices, and put into jars with salt and water for a few hours, or just sufficiently long to take away any earthy flavour. Then the slices are rinsed in clean water, and are put into a jar with a thin syrup made from white sugar. Change the syrup in three or four days, or as soon as it shows signs of fermenting. Reboil it, adding more sugar, and pour it upon the ginger again. This may have to be done three or four times, until the ginger has lost all its wild flavour, and is perfectly sweet and aromatic. It can then be covered up for future use.—QUEENSLAND AGRICULTURAL JOURNAL.

FRUIT.

MANURING BANANAS.

R. G. BARTLETT.

By experiments carried out in different places, it has been conclusively proved that potash is most essential to ensure successful results from the manuring of bananas. Owing to the war, potash cannot be obtained, as Germany was the sole source of supply. Growers are therefore in rather a quandary as to what is the best thing to do under the circumstances. Numerous inquiries on this subject have led the writer to give a short resumé of his investigations on this subject, with acknowledgments to J. C. BRUNICH and ALFRED E. STEPHENS.

The Influence of Lime.—The chief function of lime is a mechanical or physical one on the soil texture. Heavy clayey soils are rendered more friable and less tenacious, whilst, on the other hand, light, sandy soils are made more retentive by its use. It is the chemical action of lime, however, which concerns us most closely at present. Lime counteracts any acidity and destroys the ill-effects of certain soluble iron salts.

It, again, liberates valuable mineral plant foods, chiefly potash, existing in unavailable form, and helps in the decomposition of organic (vegetable, etc.) matter.

Lime favours bacterial activity by counteracting the formation of excessive and undesirable acidity. Particularly does it assist the valuable bacteria of nitrification, which change ammonia salts into nitrates, and in making the nitrogen available to plant life. It is only by the action of the myriads of bacteria, with which every fertile soil teems, that the different plant foods in organic materials are made available to the crops.

Lime, as a direct plant food, is commonly present in most comparatively virgin soils in sufficient quantities. With constant cropping, cultivation and the action of the continuous use of certain fertilisers, such as sulphate of ammonia, superphosphate, dried blood, etc., the lime becomes gradually removed, so that the soil, besides becoming possibly actually deficient in lime as a plant food, also acquires an acidity or sourness unfavourable to successful plant growth.

It therefore follows that, where orchards have been previously manured heavily with potash and dried blood, sulphate of ammonia, or superphosphate, without periodical applications of lime, great results may be expected from applying heavy dressings of lime, followed two months later with applications of dried blood and superphosphate.

In order to demonstrate this, the bananas on the school plot were given a heavy dressing of lime—4 to 5 lb. per stool—at the end of July, while this month (October) 2 lb. of dried blood and 1½ lb. of superphosphate were applied to each stool.

Slaked lime (agricultural lime) is recommended in preference to limestone screenings which, though cheaper, are slower in action.

It must not be inferred that potash manures can be dispensed with altogether, but that, so long as sufficient potash is present in a soil, either naturally or as a result of previous heavy potash manuring, liming and manuring as above will help to temporarily dispense with the necessity to use further potash.

Remarkable improvement is noticed in the school vegetable plot from the use of lime this year. Hitherto only very average results have been obtained, even when manuring the vegetables with farmyard manure, with the addition of dried blood, superphosphate, and potash. So much has this been the case, that successful vegetable growing under ordinary conditions was almost despaired of. Lime has changed all that. Light dressings of lime before digging up the beds and the addition of small quantities of lime to the water-tank and the vegetables, now bear comparison with the best, even though artificial fertilisers have been dispensed with.—QUEENSLAND AGRICULTURAL JOURNAL.

DISEASE OF MANGO.

A bacterial disease of the mango is reported from South Africa, whereby a large percentage of the fruit falls to the ground whilst yet immature. Infection occurs on leaves and branches as well as fruit, and so the disease is propagated from one crop to the next. On twigs and branches discoloured spots occur which are followed by gumming and the development of deep cracks. The disease has been found to be a rod-like bacterum (*B. mangiferæ*). Infection is carried by wind and distributed in the tree itself by rain water.

TOMATO GROWING.

Sow the seed in rows 3 or 4 inches apart, $\frac{1}{4}$ to $\frac{1}{2}$ inch apart in the row, and cover about $\frac{1}{2}$ inch deep. After the seeds have been covered, water the surface of the soil with a sprinkling can, being careful to distribute the water uniformly over the bed.

Water the bed in the morning and on bright days. The seed bed should never be allowed to dry out, but great care must be exercised in watering, as excessive moisture is conducive to the development of damping-off.

For a very early crop, transplant the young plants as soon as they develop their first true leaves. The plants may be transplanted to stand 2 inches apart each way in the bed, and when the plants reach a height of 3 or 4 inches and begin to crowd each other in the bed they should be taken up and transplanted again. Old tomato cans which have had the tops and bottoms melted off are very satisfactory for this purpose where the work is done on a small scale. On a large scale the grower will very seldom go to the trouble of transplanting the plants more than once, and quite often they are taken direct from the seed bed to the field. Where earliness is an

important factor, the plants should be transplanted at least once, and on a small scale it will pay to transplant twice.

Before the plants are set out they should be hardened off, and this must be done gradually in order to prevent any serious check to growth.

Seeds may be sown in beds or boxes. The boxes should be filled with a rich, mellow soil and the seed sown the same as in a hotbed. Unless the plants develop in the light, they will be weak and spindling. Close attention must be given to watering. On warm days the boxes containing the plants may be placed outside in the sun.

Select, if possible, a well-drained sandy or sandy loam soil, preferably one nearly level. Avoid land that has been in tomatoes the year before, especially if there has been any disease on the plants, as many of the diseases live over winter in the soil. Soil on which cotton or any other crop has been injured by nematodes, or gallworms, causing root-knot, should also be avoided.

Plow the land in the fall if there is no danger of washing. Replow in the spring and thoroughly pulverize the soil by disking, harrowing, and dragging, or rolling. The depth to plow depends on the condition of the soil and the previous treatment it has received. A deep soil is desirable for tomatoes, but it would not be advisable to plow 8 inches deep if the previous plowing had been only 4 inches deep. It is best to deepen the soil gradually, plowing 5 or 6 inches deep the first year and a little deeper each year until the desired depth is reached.

Barnyard or stable manure is valuable for tomatoes on most soils, as it adds both fertilizer and humus. Coarse manure may be applied broadcast at the rate of 20 tons or more per acre and plowed under. This should be applied in the fall and plowed under or applied to the crop preceding the tomatoes. If well-rotted manure is used, apply it broadcast after the land is plowed. Thoroughly harrow it in and mix it with the soil before setting out the plants.

In addition to the manure, most soils need some commercial fertilizers, especially those furnishing phosphorus and potash. It is a good plan to apply a fertilizer that contains some nitrogen in a readily available form. For an average soil in the South the following fertilizers will give good results when used with manure : 100 to 150 pounds of nitrate of soda, 500 to 1,000 pounds of 16 per cent. acid phosphate, and 150 to 300 pounds of muriate of potash to the acre. On poor land use the larger quantities, Where no manure is used apply 400 to 800 pounds of cottonseed meal in addition to the other fertilizers mentioned. If a ready-mixed fertilizer is used, one giving 2 per cent. of nitrogen, 8 per cent. of phosphoric acid, and 6 per cent. of muriate or sulphate of potash will give good results. Commercial fertilizer will not give good results unless the soil is well supplied with humus. Where manure can not be secured, some crop such as cowpeas, soy beans, or some other legume should be turned under to supply humus and part of the nitrogen.

When large quantities of fertilizer are used, apply it broadcast and harrow it in. Fertilizer applied at the rate of 500 to 1,000 pounds per acre should be distributed in a strip along the row or in a furrow and thoroughly mixed with the soil to prevent the burning of the plants.

Have the soil well prepared before starting to plant. Mark off the rows about 4 feet apart. The distance to set the plants in the row depends upon the methods of growing. If the plants are to be pruned to one or two stems and tied to stakes or trellises, 2 to 3 feet apart is sufficient space to give between the plants in the row. Where the plants are not pruned and staked, set 3 to 4 feet apart in the row. In a small garden where the plants are pruned and staked and all cultivation is done by hand, the rows can be $2\frac{1}{2}$ feet apart with the plants 2 feet apart in the row.

Before taking up the plants, thoroughly soak the bed in order to have as much soil as possible adhere to the roots of the plants. Take up the plants with a trowel or spade and pack them in boxes to carry to the field. When the plants are grown in pots, all of the soil should remain around the roots. Set the plants in the furrow and pack the soil around them with the hand. Do not open the furrows very far ahead of the planting, as the soil dries out when exposed to the air. When the soil is very dry at planting time, use enough water to moisten the soil around the plant, and after the water has soaked into the soil pull some loose dry earth over the moistened area.

Give the tomatoes frequent shallow cultivation in order to keep down the weeds and maintain a loose soil mulch over the surface to prevent evaporation. Cultivate after each rain, as soon as the ground is in condition to work. Do not allow a crust to form. As a general rule, a small-tooth cultivator should be used rather than a shovel plow, sweep, or turnplow. Keep the soil loose between the plants by the use of a hand hoe, and keep the weeds down at all times, as they rob the soil of moisture and plant food that should go to the tomatoes.

It is customary in the South to prune the tomato plants and tie them to stakes. Soon after the plants are set out a stake made from a sapling, a mill edging, or a 1 by 1 inch strip 4 or 5 feet long is driven down near each plant and the stem is tied to it. The plants are pruned to one or two main stems, and all the shoots that grow in the axils of the leaves are pinched out. These shoots should not be allowed to get large, as they take the nourishment away from the main stems. Use a soft twine for tying the plants to the stakes and have it loose about the stem, so as not to interfere with the development of the plant. A good plan is to loop the string around the stake and tie it around the plant under a leaf stem. Go over the field once every week or 10 days to pinch out the shoots and keep the plants tied up to the stakes.

The staking and pruning will expose the fruit to the air and sunlight and cause it to ripen more evenly than if left lying on the ground. The fruit will also be earlier and more uniform in size, but the crop will probably not be any larger. The tomatoes can be cultivated and sprayed to better advantage when trained to stakes or trellises of any kind.

Tomatoes should not be grown on the same land year after year, because some diseases live over winter in the soil and injure the new crop. The soil can be kept in better condition by following a system of rotation, especially when some leguminous crop is grown. Potatoes, eggplants, and peppers should not follow tomatoes, as some of the same diseases and insects affect all of these plants. It is better to follow tomatoes with such crops as peas,

beans, cabbage, or a general farm crop. It would be a good plan to plant a cover crop on the land after the tomatoes are harvested. Where the season is long enough for getting a good growth, cowpeas, crimson clover, or some other leguminous crop should be grown. If the tomatoes are not harvested until late summer or fall, rye or oats and winter vetch could be sown for a cover crop and turned under. The year preceding the growing of tomatoes it would be a good plan to grow corn with cowpeas, soy beans, velvet beans, or peanuts between the rows. Turn under the vines and corn stubble in the fall or winter to furnish humus. Whatever system is followed, a leguminous crop should be turned under once in two years. This can be done the same season a money crop is produced.

There are many diseases affecting the tomato in the South, and in order to grow the crop successfully it is necessary to practice certain preventive measures as follows :

(1) Where diseases are causing considerable damage, tomatoes should not be planted on the same land more than once in three years.

(2) Practice a good system of rotation, but avoid growing potatoes, eggplants, and peppers in the rotation with tomatoes, as some of the same diseases affect all of these plants. Do not plant tomatoes on land that has grown any plant affected with rootknot.

(3) Do not use soil for the seed bed that has grown diseased plants. It is best to change the soil in the seed bed each year.

(4) As a preventive measure spray with Bordeaux mixture every week or 10 days, giving the first spraying before removing the plants from the bed. Tying the plants to stakes is an aid in thorough spraying and allows a free circulation of air.

(5) Practice a system of cultivation which keeps the plants in a thrifty growing condition at all times. A weak or stunted plant will ordinarily be injured by disease quicker than a strong-growing plant.

(6) Where the blossom end-rot is serious, practice irrigation, if possible, as lack of moisture is probably one of the main causes of this trouble. Spraying is of no value to keep this disease in check.

(7) Avoid the use of fresh manure the same season the tomatoes are grown.

(8) Pull up and burn all diseased plants when disease first appears.

To secure the best results in spraying, the spray material should be applied before the disease appears, as all treatments are preventive rather than curative. Begin the spraying while the plants are still in the seed bed, and keep the plants well covered with the spray solution at all times. Use a nozzle which gives a fine mist; thoroughly cover but do not drench the plants

Bordeaux mixture is the best preparation to use as a spray. The formula for making it is as follows:

Copper sulphate (bluestone)		...	4 pounds
Quicklime ...	...	...	4 pounds
Water ...	...	...	50 gallons

Dissolve the copper sulphate by suspending it in a bag near the top of the water in a wooden or stone vessel. Slake the lime in another vessel, dilute each solution separately up to 25 gallons, and pour together the dilute solutions. Stir the mixture thoroughly while the two ingredients are being united, and keep it well stirred while it is being applied. After the solutions are poured together they should be used immediately.

When Bordeaux mixture is used in large quantities, it is advisable to make stock solutions. This can be done by dissolving 50 pounds of copper sulphate in 50 gallons of water, slaking 50 pounds of lime, and diluting to 50 gallons. The stock solutions must be thoroughly stirred before they are used, in order that they may be of uniform strength throughout. To make up 50 gallons of Bordeaux mixture, take 4 gallons of the copper-sulphate solution and dilute to 25 gallons and 4 gallons of the lime water diluted to 25 gallons. Then pour the two solutions together into the spray tank, as already described.—U.S.A. FARMERS' BULLETIN, 642.

EFFECTS OF WIND ON LIME TREES.

The question of the influence of wind on lime trees has been recently brought under renewed consideration by a report of the Mycologist of the Imperial Department on conditions in Montserrat. From various considerations it is suggested that an increase of vigour would be obtained as a result of closer protection, which would enable the trees to resist the attacks of root grubs, scale insects, and certain weekly-parasitic root and stem fungi which at present give trouble in that island.

As a contribution to the discussion the Commissioner of Agriculture invited an expression of views on this subject from the principal agricultural officers in Dominica and St. Lucia, these being the islands in which lime cultivation has received most attention. The communications received are given below, and it will be seen that the results of experience in the two islands are in very close accord.

MR. JOSEPH JONES, Curator of the Dominica Botanic Gardens, writes:—"Generally it may be stated that 95 per cent. of the lime cultivation in Dominica lies snugly in sheltered valleys or under the protection of windbreaks. Mistakes may be made by planters, particularly young men from England who are engaged in learning planting, but when it is perceived that the fields are subject to persistent winds, and that windbelts cannot be established, or if established would not adequately protect the lime trees, as in the case of rising ground, then attempts to establish lime fields under such conditions are abandoned.

"I have in my mind's eye a picture of a large field of limes on a windward estate. The lower part of the field is protected by windbelts, the results in crop being good. The upper part of the field is exposed to the trade wind. Here the trees are stunted, with the usual dead tops, and the crop obtained does not pay the cost of weeding the field.

"Lime trees can and do stand a considerable amount of wind provided there are periods of comparative calm between when young growth can be made and hardened. It is the persistent deadly trade wind which blows for months on end that is to be feared. This stunts the plants from the start and portions of the small branches dry up, but the trees do not die. They struggle on, and with alleviating conditions, such as windbreaks, may ultimately succeed, but do not become first rate cultivations. I do not know of any lime trees, young or old, being actually killed by the effect of the wind. Possibly this is due in a measure to guava and other bush springing up quickly in abandoned fields and affording some protection.

"There have been cases in which young planters, ignorant of the effect of the wind on lime cultivation, have considered windbreaks unnecessary and caused them to be cut down. In each case the results have been disastrous. The only means of again improving the cultivation and making it profitable is by the long process of establishing new windbelts.

"In Dominica experienced planters and all the peasants know that the chief enemy to cultivation is persistent wind. This knowledge has become ingrained owing to long association with cacao cultivation. The importance of thoroughly understanding the effect of wind on cultivation may be illustrated as follows:—Suppose that two island communities with similar climatic conditions and topographical features were about to embark on lime cultivation. Suppose that in one island sugar had been the staple crop, in the other, cacao. There is no doubt in my mind that the cacao planters would build up a successful lime industry while the cane planters were blundering along, because one community (cacao growers) had been compelled to study the effect of the wind on cultivation and would act on the knowledge gained, and the other (cane growers) had no particular need to trouble about it, and consequently would give little or no thought in the initial stage to this important factor in lime growing.

"Although lime trees can stand much more wind than cacao, there is no doubt that this cultivation must receive a considerable measure of protection if good results are to be obtained."

MR. ARCHIBALD BROOKS, Agricultural Superintendent, St. Lucia, writes:—"If the plants are set out in a field exposed to strong winds the plants do not make good growth in the early stages. They form smaller leaves, often only half the size of those previously formed in the nursery beds. The shoots are stunted and often possess more spines than leaves. The plant seldom if ever dies from the wind, but lingers until killed by pests or disease.

"Sometimes young limes are planted in such situations that they are only exposed to strong winds at certain seasons of the year (about March and April); in such instances the plants make good growth during the rainy season, and are partly stripped of their leaves during the months mentioned. This sometimes accounts for lime plants being found in a lingering state when eight or ten years old.

"Again limes are often planted where they have sufficient protection during the first few years, but later their tops extend beyond this protection and at once become stunted.

"I doubt very much if there is any authentic case on record where any lime tree has been directly killed by wind.

"Wind is undoubtedly one of the greatest evils with which we have to deal in lime cultivation, and I believe it will be found that the condition of much of the diseased and unprofitable lime cultivation now existing is indirectly caused by insufficient protection.

"Limes should be protected from wind in exactly the same way as cacao, not with the object of maintaining a heavy humid atmosphere such as cacao requires, but one sufficiently humid to prevent the young shoots and leaves from becoming wind-hardened.

"Whether the lime tree is originally planted in an exposed position or whether it extends until it becomes exposed does not affect the case. From the time of its exposure to wind its progress is stopped and it becomes unprofitable and unhealthy until the conditions are improved."

The actual physiological effects which wind or, it would be better to say, exposure produces in the plant organs have as yet received little attention. Reduction in size and increase in thickness of the leaves is well known to occur in many plants as a reaction to conditions which tend to induce increased transpiration, or where the supply of water is for any reason inadequate. The effect of this reduction on the economy of the plant has not, so far as the writer is aware, been closely investigated, but stands in familiar association with reduced or even stunted growth. No doubt it is some degree of this condition which MR. BROOKS refers to as "wind-hardened." It is evident that for economic efficiency the lime tree requires to be grown under circumstances in which it is free to develop the softer and more generous type of foliage. The factor controlling this ability is atmospheric humidity, which in exposed situations is liable to be dispersed by the freely moving air. Hence the need for wind-breaks.

The writer has little doubt that another factor is of considerable importance, not so much in the typical districts of Dominica and St. Lucia perhaps, but on lands such as those of Montserrat where the country is more open and the dry season more pronounced, namely, the loss of moisture from the upper layers of the soil. The lime is normally a surface feeding tree. When grown in districts liable to seasonal drought the root system develops at a somewhat deeper level, but indications have been found that the fibrous roots developed in the wet season are killed out in the dry months, sometimes to a serious extent. One of the results of exposure is a marked increase in this effect. It is permissible to inquire whether in some cases the highly beneficial results obtained from heavy applications of vegetable mulch have not been largely due to its action as a soil covering rather than to the manurial effects more commonly attributed to it in this connection. The quickness of the results obtained in some observed cases seems to support this view. On the other hand, the presence of large quantities of growing herbaceous vegetation about the tree increases the rate of loss, and it would seem desirable to reduce its transpiring surface as much as possible by cutting it just before the advent of the dry season.—W. N. in AGRICULTURAL NEWS.

MR. DIVERS, V.M.H., Belvui Castle Gardens, Grantham, writing to the GARDENERS' CHRONICLE about a remarkable crop of potatoes raised on the gardens, asks if it constitutes a record. The crop weighed 43 tons per acre in addition to small tubers which, however, were not numerous. The crop was not given any special attention.

FIBRES.

RAMIE CULTURE AND DECORTICATION.

MR. HERBERT CARTER.

Ramie should be capable of yielding much larger crops of useful fibre per acre, per annum, than those now obtained in India. The best yield to be secured to-day is estimated as being one-third of a ton of useful fibre per acre, per annum; yet in Haute-Vienne, in France, in a soil and climate apparently no better suited for the growth of the plant than that of India, and one in which the plant has winter and frost to contend against though drought is uncommon, a yield is got of two tons of useful fibre per acre annually in cultivation. The land is manured every three years, and each spring it is weeded, while if drought occurs it is watered. The plants upon it have been set 1ft. × 1ft. apart, always, which is very much closer than the distances observed in planting in India to-day. That Ramie is not much more extensively grown in India is due to the fact that planters consider the prices offered by Ramie spinners for the fibre at present are not in accordance with its merits as a textile. Spinners do not show the grower a sufficiently encouraging profit upon his labour. Other field crops pay planters better, but this condition of affairs would be soon altered if planters by adopting a better system of cultivation were able to get larger fibre crops from off their land.

As drought does occur in India, irrigating trenches have to be ploughed between the lines in which the plants are set, and the horse, or more frequently, the ox plough has to be put through these trenches after every cutting of matured stems in order to clear them of earth which has fallen in at various places, and weeds which have sprung up, which if allowed to remain would destroy their irrigating power. The passage of the plough takes up a good deal of land space, and the best authorities on Ramie culture are agreed in saying that if the maximum yields of useful fibre are to be got not a single foot of good productive land on a growing estate should be allowed to go to waste. There are many advantages to be gained by planting Ramie close instead of wide. For example, we have it on the authority of Dr. Royle, formerly Advisor on Economic Products to the Government of India, as stated in his standard work "The Fibrous Plants of India," that where such plants as Flax, Hemp, and Ramie are planted close, instead of wide apart, as the sun's rays and atmosphere have less free entrance amongst them the sap in them does not become so dried up, and so not only is a longer, stronger, and softer fibre serviceable for textile manufacturing obtained from them than when they are planted at wide distances apart but, in addition, much larger yearly crops of useful fibre. Close planting has, further, been amply proved by Mons. Faure, who grows Ramie at Limoges, Haute-Vienne, to induce the rigorous growth of tall, straight stems. These are the kind of stems which decorticate the easiest, and with the least fibre waste in decorticating machines to get rid of the stem's centre woody core, and extract the bast which lies between these two and which contains the useful fibres. Ramie, therefore,

in order to succeed as a fibre crop should be planted as close as possible. One circumstance which should enable this to be done, in the future, is the fact that MESSRS. RANSOM, SIMS, and JEFFERIES, the well-known agricultural implement makers of Ipswich and Bury St. Edmunds, in the South of England, make a small, narrow plough, weighing only 25 pounds in weight, which can be dragged along the fields by two people one in front of the other by pulling at a rope. This plough they have already exported to India. The space which it occupies, it need hardly be said, is much less than that which a broad ox or horse plough takes up.

It might be found quite wide enough apart in Indian and general Ramie cultivation if the plants were set at one foot or fifteen inches distance apart from each other in the rows, and the lines of plants were drawn two feet distance apart from each other. The horse or ox-plough could be used to plough the fields in the first instance, before the planting is undertaken, and then such a narrow hand drawn plough as that MESSRS. RANSOM, SIMS and JEFFERIES make be used, afterwards, to clear the irrigating trenches. Land waste would be totally avoided, if this were done. In some places to-day Ramie is grown as wide apart as four feet by four feet, always, in India, and two feet between each plant set in the lines, and three feet space between each line of plant seems to be the general distance observed. Clearly too much good land space is left around each individual plant in these cases, and the theory that a less number of plants on a given surface space will, individually, yield a larger number of tall stems than a large number of plants set upon the same surface space seems to be wrong; in fact, experience in culture in Haute-Vienne proves it to be absolutely wrong. MONS. FAURE sets 40,000 plants to the acre on his land at Haute-Vienne. Ramie in its growth calls for one good deep hoeing once a year, besides which there should be two light hoeings to keep down all weeds. One good manuring every second or third year answers best. These remarks apply to its culture in the East.

The next most important thing for the cultivator to watch is to see that he gives the plant no more than a sufficiency of moisture in its growth. If the plant is allowed to get too much moisture, while it will shoot up quickly, its fibre yield will be small and poor in quality; if it receives too little moisture, it will languish and its growth will be stunted; while if both these conditions are allowed to prevail in any one season, the plant will yield irregular fibre which will make a great deal of waste in preparing and spinning in the mills, and only small crops. No doubt the officials of the Agricultural Research Institute, Pusa, or of the Economic Products Department, Calcutta, will, if asked by cultivators to do so, be able to tell them pretty accurately what is the correct amount of moisture to supply to the plants in the various districts in India, and nothing promotes the growth of Ramie better than to strip the leaves from the stems at the harvest and hoe them into the ground, collect the centre woody cores of the stems in heaps in the fields, burn them, and hoe their ashes into the soil; and generally return to the soil all the refuse of decortication; green woody matter, pith, oxidised juices, etc., all should be spread over the fields, and returned to the land.

To want in the moisture supply may be attributed the faults of brittleness, and lack of strength when they show themselves in the fibre, and these, it must be remembered, are seized upon by many as an excuse to belittle its

natural merits and offer only poor prices to growers for it. The less frequently these faults manifest themselves the better for the industry. Once the culture of Ramie is thoroughly understood, there should be no industry in India more extensive or profitable. Great care in the above respects is, or rather has been, up to lately, exercised by all German overseers of lands in China, on which Ramie, or China grass was cultivated for use in Germany and Austria.

As for the decortication of the fibre or the extraction of the useful bast, one method other than machine preparation is worthy of official notice and consideration in the East, although it must be clearly understood that its product is not liked by Ramie spinners nearly so well as China grass, or hand cleaned Ramie or Ramie cleaned like China grass by any machine which does not damage the natural good qualities of the fibre in any way. This is the process of Steam Decortication. In this process the green stems when cut are placed in boxes, eight feet long, two feet wide, and three feet deep, made of good wood, having a lid on hinges at the top, and each being provided with a perforated false bottom under which runs a coil of metal piping for steaming purposes, each box having an aperture at one of its bottom corners for the escape of the condensed steam, and the lids being closed, steam which is superheated is injected into the boxes at 302° F. for fifteen minutes for fresh green stems, 352° F. for dried stems from a small portable boiler, having a fire-box beneath it filled with water nearly to its top, which may be moved on its wheels from one part of the plantation to the other. At the expiration of this time the box is opened and the stems taken out; it will be found that the connection between the outer cuticle or skin of the stem, the inner useful fibrous bast, and the centre woody core of the stem having been rendered very loose, the skin and bast can be easily and quickly stripped from the centre woody core of the stem and separated from one another, the centre woody cores being cast on the fields. Juveniles and old people being readily trained to do this work, they can produce a fair quantity of fibrous tissues daily. These tissues should be rinsed in clean water. While the contents of one box are being steamed, another box may be filled with stems, two boxes being used with each boiler, and as many boilers and boxes may be used on a plantation at the harvest as its owners think fit. The steam does not seem to harm the good qualities of the fibre in any way. The tissues are a good article, and though not liked as well as China grass, they are a better article in every way than Black Ramie Ribbons, as, having no cuticle upon them they are easier to degum, and the good strength of the fibre so runs less risk of being damaged. With practice in this method of separating the fibre, juveniles and old people should become more and more expert. The steam generated in the boiler should be conveyed to the metal piping which runs underneath the wooden chests or boxes by means of a coil of piping. When the separation of the tissues from the cuticle and centre woody cores of the stems has been effected the tissues should be rinsed in clean water and dried carefully. The planter should bear in mind that nothing is more conducive to brittle Ramie and Ramie of weak strength generally than to bale it in a damp condition, for when this is done fermentation sets up in the fibre on its way to the mills and rots it.

The variety *Boehmeria nivea*, the underneath sides of the leaves of which are silvery white in colour, which is the variety indigenous to India, is

the best variety to cultivate; it possesses undoubtedly superior spinning qualities to the fibre of *B. tenacissima*, the upper and lower portions of the leaves of which are quite green in colour, because while its textile strength is not quite as good as that of the fibre of *B. tenacissima*, spinners find they can spin it into much finer counts of yarn than they can the fibre of the last named variety. This circumstance would seem clearly to prove that its all round strength makes it much the better of the two varieties.

Another reason why Ramie should be sown close is because this checks side branching of the plant which is fatal to uniformity of fibre, and the more uniform a fibre is the higher is its market value. Every break in the parent stem tends to destroy the continuity of the fibre; and it is essential that this should be preserved, as far as possible.

Endeavours to ret Ramie have, up to the present, ended in disappointment, as it is found that the fibre rots quicker than the cuticle. This is to be explained by the quantity of gummy and green matter it contains; in fact, the fermentation proceeds too rapidly. Antiseptics, such as permanganate of potash and boracic acid have been added to the ret vat to retard the fermentation, but even this has failed to secure a result which is satisfactory; indeed, if a strong fibre is to be got the less Ramie is touched by chemicals in its preparation for the market, seeing it has later to be chemically degummed, the better; and there is no doubt machine decortication is far better than the employment of drugs for this purpose, provided the machine does not damage fibre in any way.

With respect to the Bacterial Degumming of Ramie, which method has lately been invented, and patented by an Italian gentleman and is said already to have shown good results in tests in Italy, chemical aid is only very slightly utilised. The inventor is very confident of its efficacy, particularly in its not injuring the fibre's good strength, elasticity, etc., in any way. PROFESSOR DR. GIACOMO ROSSI, the inventor, is teacher of Bacteriology at the Royal School of Agriculture, at Portici, Italy. The writer hopes to give some full and accurate details of this new method of degumming Ramie, which cannot possibly fail to be of great value to India, in a later article. There are, however, several chemical degumming processes in existence to-day, and in commercial operation on a large scale, which do no harm to the natural good qualities, strength, etc., of Ramie, as, for example. the process used by Le Sociète de la Ramie Francaise, (MESSRS. P. A. FAVIERO CIE.), Extraignes, Vaucluse, France.—THE MYSORE ECONOMIC JOURNAL.

THE CULTIVATION OF SISAL HEMP.

The Sisal plant requires a tropical climate with moderate atmospheric humidity. It is very hardy, but is liable to be injured by excessive rain.

It is usually stated that the plant flourishes on rough, dry, stony or rocky soils which are unsuitable for other crops, but there is little doubt that good soils are not unfavourable. On poor soils, the plants are of somewhat inferior appearance, but yield leaves containing a large proportion of fibre, whilst on rich soils longer leaves are produced which furnish comparatively less fibre.

It is probable, however, that in the latter case the greater length of the leaf more than compensates for the lower percentage of fibre. In general, it may be stated that the most suitable soil is a dry, permeable, sandy loam, containing a certain amount of lime. Good drainage is of great importance, as the roots of the plants are sensitive to moisture and are liable to be seriously injured by standing water.

PREPARATION OF THE LAND.

The land selected for a plantation should be fairly hilly in order to allow of easy drainage. Most writers agree that it is not necessary to break up the soil to any great extent ; but the land must be cleared of trees and scrub, and stumps must be uprooted in order to render the surface even. On the other hand, it is stated that in German East Africa the best results are obtained on land which has been thoroughly cleaned and well hoed. In any case, it is essential that the undergrowth should be removed, as, if the Sisal plants are shaded, the fibre becomes weak and inferior. The land subsequently requires to be lightly hoed four or five times a year in order to keep it free from weeds.

PLANTING.

The Sisal plant comparatively rarely sets seed, and its propagation is therefore effected by means either of bulbils which are formed in the manner already described or of suckers which arise from the rhizome. The bulbils are usually grown in nursery beds until about 8 to 12 inches high, and are then planted out. Suckers can be planted immediately after their removal from the parent plant. Planting is generally carried out during the rainy season, all fibrous roots and lower leaves having been first removed to facilitate new growth. The plants should be set in rows about 8 feet apart. The distance between consecutive plants in the row varies a good deal in practice, but probably 6 feet is generally the most satisfactory, this arrangement admitting about 900 plants per acre.

HARVESTING AND YIELD.

The period which must elapse before harvesting can be begun varies in different countries ; but, in general, after about from three to five years healthy plants will yield leaves ready for cutting. The cutting is effected by means of a special form of blade or sickle with a curved end. Each leaf is cut off close to the trunk, care being taken not to injure the younger leaves on the plant. The number of leaves which can be cut per annum varies greatly. It is estimated that in Mexico each plant yields about twenty-five leaves a year, whilst in East Africa double that number are obtained. The average weight of the leaves in the latter country is about 2 lb., and the yield of dry fibre is approximately 3 per cent. Hence the yield of fibre per acre containing 900 mature plants should amount to about 2,700 lb., and a yield of at least a ton per acre may therefore be anticipated.

As the result of actual trials carried out at Punda Milia, it was found that 912 leaves, weighing 2,263 lb., or an average of 2·48 lb. per leaf, yielded $52\frac{1}{2}$ lb. (2·32 per cent.) of dry, brushed fibre, equivalent to about 1 lb. of fibre from 17 leaves. The plants from which these leaves were cut out were spaced 8 ft. × 8 ft., this arrangement giving 681 plants per acre. Taking 160 as the average number of leaves produced per plant during its life, the total

yield per acre, when calculated by means of the above figures, is 6,240 lb., or a little less than 3 tons. As the plant lives at Punda Milia about three years after the first leaves are ready for cutting, these observations are in agreement with the estimated yield of 1 ton per acre per annum given in the preceding paragraph.

DURATION OF LIFE OF THE PLANT.

As has been already stated, the duration of life is determined by the production of the pole or inflorescence. In Mexico the plants are said to live for fifteen, or sometimes even twenty-five, years before poling, whilst in more tropical countries they live a much shorter period, the average length of life in East Africa being only about six years. In general, the duration of the plant appears to be largely dependent on conditions of soil and climate. It has been asserted that the life may be prolonged by cutting out the pole as soon as it appears above the leaves, the plant being thus rendered available for fibre for nearly a year longer than it would be otherwise; but experiments which have been conducted in German East Africa do not support this view. The early poling of Sisal plants in East Africa has been much discussed, and has been regarded by some planters as a great disadvantage. It appears, however, that the comparatively short life is due to the fact that there are two growing seasons in that country, and growth is checked twice a year, whereas in less tropical countries there is only one growing season per annum. Thus it is evident that the plant in East Africa lives through approximately the same number of growing seasons as it does in other countries, but only about half as many years. Moreover, the number of leaves produced per plant (on the average about 200) is roughly the same in each case, and hence the comparatively brief duration of life is rather an advantage than otherwise, as the total crop of the plant is produced in a relatively shorter time.

Since the plants in a Sisal plantation do not all pole at the same time, the work can be carried on continuously by the intercalary method sometimes adopted in German East Africa. As the plant lives for only about six years, cutting can only be carried on for two or three years before it dies. New plants are therefore continually inserted between the old ones, so that when one plant dies another is ready for cutting, and the work of the plantation can proceed without interruption. Some planters, however, do not approve of this method, but prefer to let all the plants in a plantation pole and die; and then allow the land to lie fallow for a year or more before replanting.

EXTRACTION AND PREPARATION OF THE FIBRE.

The fibre is extracted from the leaves by a process of crushing and scraping or "scutching." The leaves should be treated as soon as possible after they have been cut, as otherwise the juice becomes dry and gummy, thus rendering extraction more difficult. They should be graded according to length before being scutched, and the fibre of the different lengths should be kept separate. The strands of fibre must be kept as parallel as possible and not be allowed to become tangled. It must be borne in mind that good white fibre of uniform length and carefully cleaned and baled commands a much higher price than mixed fibre, ill-cleaned and badly baled.

Modern machinery for Sisal hemp extraction is based on the principle of the old "raspador" which was the earliest form of machine employed in Mexico. This machine consists of a wheel, like a 4-ft. pulley, with a 6-in. face, and with pieces of brass running across the face at intervals of about 12 in. The wheel runs in a heavy wooden case and makes about 110 revolutions per minute. The leaf is inserted through a small hole in the case, and held firmly at one end by a strong clamp, whilst the rest of the leaf is allowed to whip downwards as the wheel rotates. A heavy concave wooden block, like the brake of a car-wheel, is brought by means of a lever on to the leaf and presses it against the revolving wheel. The leaf is thus crushed and the pulp and epidermal tissue are scraped away by the brass strips and thrown into a pit under the wheel. The fibre is then withdrawn and the leaf reversed, in order that the other end may be cleaned in the same manner.

The machines which are chiefly used in East Africa are the "New Corona," the "Mola," and the "Finigan-Zabriskie."

The "New Corona" machine, manufactured in Germany, is said to be capable of extracting about 2 tons of dry fibre per day, requires 30 h.p. to work it to its fullest capacity, and demands the services of four workmen. It consists essentially of two scutching drums armed with scrapers which work against concentric, brass-lined, cast-iron saddle pieces. The leaves are automatically pulled through between the drum and the saddle piece, one half of the leaf being extracted by each drum. The pulpy matter is thus scraped away from the fibre, leaving the latter in a condition in which, after washing and drying, it is ready for export.

The "Mola" machine, manufactured in Merida, Mexico, needs about 48 h.p. to drive it. It works more rapidly than the "New Corona," and can extract about 3 tons of fibre per day. The extreme velocity necessary to effect this, however, causes a comparatively large amount of waste, but this loss is usually regarded as compensated by the greater output. The bundles of leaves as brought in from the plantation are placed by one or two workmen on a travelling lattice which carries them up to a table in front of the machine. Four men are then required to open the bundles and lay the leaves on the conveyor, which introduces them to two raspadors, arranged at right angles to one another, where they are cleaned, one-half the leaf being stripped at a time. The fibre on leaving the machine slides down on a wooden frame and is then washed and dried.

The "Finigan-Zabriskie," an American machine, is capable of extracting about 1 ton of fibre per day of 9 hours. It requires the services of three attendants, two to feed the leaves into the machine, and one to withdraw the fibre.

Several British firms are now manufacturing machinery for the extraction of Sisal hemp. Three machines are made by MESSRS. ROBEY & CO. LTD., London. These are (1) the "Duodecor," for the decortication of leaves not over 4 feet long, which has two drums each 4 feet in diameter, is capable of dealing with 10,000 leaves per hour, and requires a power of 50 i.h.p.; (2) the "Sixdecor," for decorticating leaves more than 4 feet long, which has two drums, one of 4 feet and the other of 5 feet diameter, a capacity of 13,000 leaves per hour, and requires 60 i.h.p. to drive it; (3) the "Twendecor" for use with extremely long leaves, which resembles the "Sixdecor" in construction, requires 80 i.h.p., and can decorticate up to 20,000 leaves per hour. One of MESSRS. ROBEY & CO.'s machines has been installed in the East Africa Protectorate on a plantation at the coast, north of Mombasa.—IMP. INST. BULLETIN.

SOILS AND MANURES.

STORAGE OF FARMYARD MANURE.

The problem of the storage and fermentation of manure has for long been a subject of discussion, pits and covered courts each having their advantages and disadvantages. A new system by DR. GIUSEPPE BECCARI, of Florence, Italy, is described in a recent publication from the Imperial Institute of Agriculture, and consists in the storing of the manure in turret-covered courts. The court is a rectangular structure of masonry, divided internally into two compartments about 7 feet high. The floor is paved and provided with drains covered with perforated bricks, through which air passes upwards into the manure, while the liquid manure drips through into a tank. In the top of each compartment there is a trap-opening through which the manure is thrown. Between the two trap-openings a turret is situated, with the object of collecting and fixing the ammonia compounds evolved from the fermenting manure, which enter by the apertures. In the turret, shelves placed above each other and fixed alternately to either side are charged with solid or liquid, alkaline or acid absorbents; these are collected from time to time through a door or other aperture in the turret, which has also openings at the top and bottom for the admission and escape of air. The manure is abundantly sprinkled every four or five days with liquid manure from the tank, and in forty-five to fifty days it is ready for use. Manure made in this way has been found to contain 0·54 to 0·89 per cent. of nitrogen, while manure made in the usual way is considered good when it contains 0·45 per cent. Besides this there is also the nitrogen fixed by the absorbents in the turret. From the hygienic point of view this system is superior to any other. It has been adopted in several parts of Tuscany, where the cost of erecting such a covered court sufficient for eight to ten head of cattle is about £26. The advantages of the system are (1) that of fermenting the manure in a closed space so that it attains immediately the high temperature of 158 to 167°F., evolving abundant ammonia and preventing the development and action of denitrifying bacteria and consequent loss of nitrogen; (2) that of collecting the volatile ammonia compounds, which are led into a special chamber (the turret), where they are transformed into stable ammonia salts or nitrates, by suitable absorbents, such as clayey earth, peat, charcoal, gypsum, acid superphosphates or an alkaline medium, and at the same time favour the development of numerous colonies of nitrifying bacteria.—GARDENERS' CHRONICLE.

LIQUID MANURE.

Stable, cow, sheep manure, and poultry droppings can be used as liquid manure.

Many people have an aversion to using these because of the unpleasant odours.

For those who prefer the artificial manures we can recommend nitrate of soda, sulphate of ammonia, sulphate of potash, and Peruvian guano. The latter manure, when good, makes a first-class liquid manure, but we prefer the first three.

The ammonia and nitrate of soda produce luxuriant growth and must be used cautiously. A tablespoonful of either to two gallons of water makes a strong manure, and seldom requires to be used stronger. It is better to make the manure half the strength for most plants, otherwise there is a danger of killing the plants. We are now referring to ordinary garden plants.

Avoid wetting the leaves with the artificial manures. Some tender annuals can't stand such treatment.

If it is necessary to use sulphate of potash with either the ammonia or nitrate of soda, the amounts used must be lessened, say, half of each. Half a tablespoonful of each to about four gallons of water is quite safe.

Don't use these stimulants oftener than once a week. Once a fortnight is much safer.

Before applying the manure, wet the soil thoroughly, then apply the liquid manure some hours afterwards.

These tonics may be used on most of our spring flowers, roses, sweet peas, pansies, petunias, and most flowering plants in the conservatories.

If you want delicate and handsome blooms, use the liquid manures very sparingly.—Queensland Agricultural Journal.

FERTILIZED PEAT.

A NATIONAL COMMITTEE.

Mr. W. B. Bottomley, Professor of Botany and Vegetable Biology, King's College, delivered at the Royal Botanic Society the third and concluding lecture on his experiments in the use of bacterized peat as a stimulant to the growth of vegetables, flowers, and grass.

Sir Malcolm Morris, who presided, read a letter from the Duke of Teck, President of the Royal Botanic Society, saying that Professor Bottomley's work would be of great service to the nation by increasing the amount of vegetables, wheat, etc., and suggesting that a national committee should be appointed to carry out experiments so that the discovery might be tested on a large scale.

The Chairman said that the council of the Society proposed to form the nucleus of a national committee to which gentlemen interested in farming from all parts of the country would be invited to join, so that Professor Bottomley's experimental work might be used to the advantage of the nation. He believed that if this were done the food supply of the country would be doubled in a short time.

Professor Bottomley, in his address, showed some remarkably fine apples, onions, carrots, mangolds, and Brussels sprouts, grown in soil diluted with bacterized peat, as compared with smaller specimens of the same vegetables and fruit grown in ordinary soil ; and also displayed to the same purpose a series of lantern views of experiments with the bacterized peat on plants and flowers in Kew Gardens.

He hoped the Board of Agriculture, which had sent a representative to the lecture, would be induced to take up the discovery. So far, the Board had declined to take action. When attention was recently called to the discovery in the House of Commons MR. ACLAND, speaking for the Board, said:—"So far as I am aware no result has been obtained which demonstrates its utility for agricultural purposes on a field scale and on a commercial basis." As a matter of fact, experiments had been made on a farm which showed that one ton of bacterized peat had produced 41 per cent. more potatoes, 26 per cent. more turnips, 43 per cent. more beet, 46 per cent. more onions, and 28 per cent. more carrots than 80 tons of farm dung from the same soil.

"May I give you a little bit of secret history?" he continued. "In July of last year a German professor came into my laboratory with the copy of an address I had delivered on the subject and asked to have the process explained to him. I did so. Why not? He was a brother scientist, and it was before the war. He expressed his delight, and then asked quite harmlessly that he might see the bacteria. I opened the incubator for him. He then asked for a sample, but I said 'No,' because the work was not completed. Next day he came back and told the truth. He said he wanted it for the German Board of Agriculture, and that it would be worth my while to let him have it. They didn't get it, I may tell you that. But contrast it with what we get from our Board of Agriculture."

COMMERCIAL OFFER REJECTED.

He had received an offer from a commercial man to form a limited liability company with a capital of £100,000 to purchase his rights for 33,000 fully paid up £1 shares and pay him £1,000 a year as consultant chemist; but he refused the proposal on the ground that the public would probably be asked to pay £20 a ton for the bacterized peat, which cost him only £2. 10s. a ton to produce. MR. MOND of MESSRS. BRUNNER & MOND, having tested the experiments, was prepared to advance part of the money, or even all the money required; and a gentleman in Yorkshire was willing to provide peat lands free. Therefore, the bacteria, the money, and the peat were available, and he hoped that if the Board of Agriculture still refused to act, the national committee to be formed by the Council of the Royal Botanic Society would take steps to make the bacterized peat and distribute it to the people at cost price.

MR. WATSON, the Curator of Kew Gardens, said PROFESSOR BOTTOMLEY should not be so hard on the Board of Agriculture, for Kew Gardens, which were under the Board, had assisted him in his experiments. He confessed that he had yielded somewhat reluctantly to PROFESSOR BOTTOMLEY's request that the bacterized peat should be tried at Kew Gardens. That, he thought, made all the more valuable his testimony to the efficacy of the material as applied to a series of plants in pots. He knew nothing as to the value of the peat in farming, but had no doubt its effect on vegetable growing in the open would be the same as its effect on plants and flowers.—THE TIMES.

HUMOGEN.

PROFESSOR BOTTOMLEY'S bacterised peat, now called Humogen, is receiving a good deal of attention in the newspapers, daily and other. In some of the notices statements have been made which are likely to raise doubt in the professional mind as to the genuineness of this preparation, whether faking practices are being resorted to, not by the Professor, but by others evidently anxious to make Humogen hum. There is no need for this. Humogen, as I know it, is an excellent fertiliser. I have seen it carefully tested on a variety of plants with convincing results. I know, too, that others, men of experience as cultivators, have also tried Humogen with results that were negative. The experiments at Kew Gardens were, with few exceptions, with plants grown in pots, and therefore under control with respect to water, light and other conditions which affect the growth and health of plants. It is probable that experiments in the open are liable to be adversely affected by, weather, etc. The soil, drainage, position, or the state of the plants themselves may possibly be unfavourable. Food, however wholesome it may be, cannot benefit either plants or animals if other equally important factors are neglected. The pressman who stated that Humogen would enable people to grow potatoes and other vegetables in ordinary living rooms all the year round had food on the brain, and any cultivator who, by applying Humogen expected to get food crops from soil altogether out of condition would be disappointed. I have not seen a single case of failure where the plants treated with Humogen have had ordinary attention. I confess to being puzzled by what Humogen does. The peat, before it is treated, even if all the acid were removed from it, would not be of any particular value as a fertiliser. The peat used by gardeners for peat-loving plants is not rich in plant food, no richer certainly, when judged by results, than good leaf-mould. An experiment in which good peat was mixed with other soil in the same proportion as that containing Humogen proves this, the peat making no difference in the growth of the plants. For this reason Humogen cannot be classed with manures, natural or artificial. All the good must come from the action of the bacteria with which the prepared peat is inoculated. They must operate on the food contained in the soil to which Humogen is added, and they evidently continue to operate for an indefinite time, for the plants nourish until their roots are pot-bound. I am inclined to believe that excess of soil moisture is most detrimental to the action of Humogen, or rather to the bacteria, not because water is destructive to them, but what we call stagnation must be. We have to bear in mind that these micro-organisms are alive, and that to enable them to do their work they must have suitable conditions. In a properly constituted soil Humogen is capable of working a change in its productivity which after a long experience with plants, soils and plant foods I am in a position to say is very extraordinary. I have never seen anything to equal it.—W. W. in GARDENERS' CHRONICLE.

BACTERISED PEAT.

This journal was, we believe, the first to call attention to the extremely interesting and promising experiments made by PROFESSOR BOTTOMLEY in the production of a novel kind of plant-food.

That plant-food known as bacterised peat is prepared by treating certain kinds of peat with certain bacteria. After this process, as a result of which the amount of soluble humates is largely increased, the bacteria are put out of action by heat, and to the treated peat is added another kind of bacterium, an azotobacter, which brings about a fixation of nitrogen. Preliminary experiments with this bacterised peat have given remarkable results. By the addition of small quantities to the soil the growth and yield of plants have been shown in many cases to be very greatly increased. In the earlier stages of his experiments PROFESSOR BOTTOMLEY attributed these effects to the large quantities of soluble nitrogen compounds contained in the bacterised peat.

The general appearance of the plants so treated suggested, however, that their luxuriant and sturdy growth was due to something more than liberal supplies of nitrogen compounds.

Now, recent discoveries of physiologists have shown that animals require not only the ordinary foods, but also minute quantities of other, till recently unknown, substances, to which the name of accessory food substances has been given. As a result of his further researches, PROFESSOR BOTTOMLEY claims that bacterised peat contains such accessory food substances. Whence it would follow that plants not only require supplies of ordinary substance-building foodstuffs—water, carbon dioxide, compounds of nitrogen, potash, phosphorus, lime, and the like—but also need for their proper development a supply of accessory food substances.

The idea is not only novel and attractive, but also in the highest degree important. Because of its novelty and attractiveness, it deserves to be received with ready sympathy by all who are concerned with the cultivation of plants. Because of its importance, it requires to be substantiated by irrefutable evidence before it is adopted.

It is clear that two issues are involved, which may for convenience be treated separately.

In the first place we may ask: Is bacterised peat a good manure?, that is, one which, the factor of price being taken into consideration, will give results better than, or at least as good as, those to be obtained by the ordinary organic and inorganic manures. Now, although it is true that, as we ourselves have seen, bacterised peat does not, indeed, produce very striking results, it is nevertheless, premature to pronounce a final judgment on this point. Experiments carried out with pot plants, by such a skilful cultivator and keen observer as MR. WATSON, the Curator of Kew Gardens, as well as those undertaken by others, are emphatically in favour of the value of PROF. BOTTOMLEY'S bacterised peat; but yet other experiments carried out on plants in open ground and conducted with no less care during the past two years have not yielded such encouraging results. We cannot at present give details of these latter experiments, because their author has not yet published them. Nor do we mention them with the object of suggesting that bacterised peat does not possess the virtues that are claimed for it. The evidence, in our opinion, so far as it goes at present, is strongly indicative that PROFESSOR BOTTOMLEY may have discovered a manure of the highest value. Yet, in the face of negative results which have been obtained, it behoves us to withhold a final judgment. Meanwhile, every encouragement should be given to PROFESSOR BOTTOMLEY to continue his experiments, and to carry out trials on an extensive scale.

The second issue involved is of even greater importance, and concerns the claim that plants, like animals, require for their proper development a supply of accessory food bodies. The argument from analogy may be urged in support of this hypothesis, and not a few facts which might seem to count against it may perhaps be met. For example, as is well known, it is possible to germinate a seed and cause it to grow into a perfect plant by supplying it only with water, air, and mineral salts. That this may be done, even with plants the seeds of which are very small, is not, perhaps, a fatal objection to the professor's theory. For it is open to him to maintain that the plants would have grown quicker and better if they had been supplied with the accessory food bodies. It is known that animals require but very small quantities of these substances, and it might be urged that the seeds of plants contain in their endosperm, or already in the embryo, the necessary minimal quantity of accessory food substances.

Suffice it to say that this issue is in like case with the practical aspect; namely, that the evidence is very suggestive that plants, like animals, require accessory food substances. At present, however, we do not think that the evidence is so overwhelmingly strong as it must be before the theory of accessory plant-food substances may be accepted as finally established.

We believe that PROFESSOR BOTTOMLEY has offered to put his discovery at the disposal of the State for the period of the war. It is a generous offer, and we think that the State should accept it, and that it should at once appoint a small commission of experts, including several practical growers, a botanist, a chemist, and a bacteriologist, to conduct a series of rigorous tests with respect to the manufacture and uses of bacterised peat. The preliminary work of such a commission need not delay the application of this new manure on a wide scale during the coming year, and it should be of the greatest use in settling authoritatively the value of what may turn out to be an epoch-making discovery.

It would be a great pity if the claims set up by PROFESSOR BOTTOMLEY, as the result of his long and patient labours, were, instead of being subject to rigid critical examination, left to take their chances among the credulous, always ready to believe in the virtues of some new thing, and the hypercritical, always prepared to show in advance that the new thing is naught. Enquiry into the kind of peat used as the raw material, the several stages of manufacture, analyses of the contents of the finished article and large-scale comparative trials of the effects of the new manure should serve in a few months to determine the true value of bacterised peat.—GARDENERS' CHRONICLE.

THE VALUE OF CHARCOAL TO SOILS.

GEO. A. RETAN.

Every farmer, gardener, and nurseryman should be familiar with the results of experiments carried on for a period of three years, which have demonstrated that charcoal can be made of great use in improving the structure and properties of the soil.

It improves the water and air content of the soil, loosens and intensifies the sub-soil, apart from the chemical materials it may carry, and from its uses

with manure. These are not theoretical but practical conclusions drawn from the use of charcoal in one of the largest nurseries in the State of Pennsylvania, under the management of the writer.

Two general classes of material are available for purposes of fertilization. In the first class are commercial fertilizers. In the second class are those indirect fertilizers which do not furnish plant food directly, but by their action upon the soil may so affect it as to make plant food available by setting it free, through the altering of the physical condition of the soil. The principal fertilizer in this class is lime. Lime is really a stimulant instead of a plant food, and its continued use may be harmful or exhausting to the soil. Air, water and heat are more necessary for plant growth than mineral food. Production depends upon the proper æration of the soil, the maintenance of a proper water content and through these two, the raising of the temperature of the soil. These conditions add plant food in that they render available the material that is stored away in soil compounds. The control of moisture in the soil lies in the physical state of the soil. If it is loose, porous, small grained, it will raise moisture freely from the sub-soil and hold it where it will be available for the plants and retard evaporation. The soil may be kept in such condition by proper tillage and by the addition of such materials as will affect a loosening and breaking up of the soil particles.

Green manure is valuable, and barnyard manure and charcoal, with constant tillage, are among the best known agents. In using barnyard manure the best part of the manure is often lost. A large part of the mineral content is washed out if the pile is exposed and the liquid portions leak out or escape in gases. Many different substances have been tried for the purpose of preventing this loss. One of the very best materials which can be used for this purpose is charcoal. This is true because of its exceptional power of absorption, it possessing the capacity of absorbing many times its own weight in moisture and also because its physical effect upon the soil and the sub-soil has been conclusively demonstrated. Charcoal is already extensively used as a deodorizer or disinfectant, and the fact should not be lost sight of that the ammonia gas, which is quite lost in the manure heap, would be absorbed by the charcoal and made available for plant use.

For many years the attempt to raise coniferous seedlings in this nursery, (Mount Alto Pennsylvania Nursery), was a comparative failure because of the hard clay soil, which greatly increased the loss from unfavourable moisture and surface conditions. Among the agents tried for the relief of this condition were green manure, fertilizers, and charcoal, and of these only the last has proved successful, as may be observed by the size and weight of seedlings developed from clay beds, fertilizer beds or charcoal beds. The seedlings are much larger and heavier and of better colour on the charcoal beds than on any other. Some fertilizer beds shew good seedling development, but the beds were not as densely covered with little trees as on the charcoal beds, notwithstanding that the charcoal beds were in the worst section of the nursery, while the fertilizer beds which show the best weights were in sections cultivated for a longer period. The charcoal seedlings averaged a weight of 250 grams for a bundle of 100 trees, as against 127 grams for a check bed in the same grade of soil. These trees were two years old. At one year the differences are not so striking but are strongly marked. One hundred seedlings from a clay bed weighed 22 grams, while the same number

from a charcoal bed weighed 40 grams. These beds contained a relatively large quantity of charcoal, such as could only be used in hot-beds, gardens, or other intensive work. But the same tendency is shown in the use of smaller quantities. Furthermore, the soil conditions are exceptionally bad in this nursery. From constant observation and experiment, the action of charcoal that makes it so valuable in the nursery seems to be entirely in the improved condition of moisture and warmth. It might be thought that charcoal would loosen the soil to the extent that it would dry easily if used in large quantities, but the opposite condition occurs. In dry periods the power of the soil to retain water is increased, and in wet seasons the soil drains quickly with a consequent prevention of fungus that always follows a wet season in a coniferous nursery. The clay beds, by reason of their caking habit in dry weather, and poor drainage in wet weather, exerted the opposite effects and the loss was much more marked. In some cases it was complete. Again, charcoal beds are much warmer, because of the darker colour imparted to the soil. This is of the greatest importance in the spring, when the ground has a tendency to be cold. Germination is almost entirely dependent on the warmth present and is consequently greatly helped by the darker colour of the soil. Since the darker coloured soil does not radiate any more rapidly at night, this heating effect is carried forward into the night and lessens the liability of damage from frost. In gardens and hot-beds, this is of considerable importance. This increased heat is of value in another direction. The æration of the soil depends upon the heating, and it will be greater in the soil which becomes warmer during the day.

Thus we find that the action of charcoal in the soil is exerted along the lines where the most can be accomplished. The physical conditions of the soil are so improved that the air, heat and moisture coming to the crop is regulated in the most advantageous manner, and mechanical analyses of the sub-soil have shown that the charcoal exerts a beneficial action at a considerable depth, 12 to 18 inches below the surface. The sub-soil beneath charcoal beds is of a better colour and better physical structure than soil from the surface of untreated beds. This means an increase in the water-holding power, and a breaking up of unavailable compounds into available plant food.

To the farmer especially, the use of charcoal extends a wide range of advantages. He can add to the value of his manure, can improve the sanitary condition of the barnyard, poultry house, hog pen, etc.; and at the same time improve the physical condition of his land. When used in larger quantities in gardens, nursery beds, and in intensive cultivation, it offers the best physical condition for the growing crop with a decrease of loss from fungal attacks. The action of the charcoal is comparatively permanent as compared with the other agents, which are used for the same purposes. Experiments carried on over three growing seasons have shown no lessening of the effects under the most unfavourable conditions. The agriculturists of the future must look forward to the conservation of the resources of the land. This is accomplished best by proper control of physical conditions with the subsequent fullest utilization of the natural forces of sunshine, air and moisture. Any man who will look forward to such a careful utilization of his land will surely increase his wealth materially.—HAWAIIAN FORESTER AND AGRICULTURIST.

ÆRATION OF THE SOIL.

A. G. DJARENKO.

Of the principal factors concerned in plant life (light, heat, air and nutritive substances), only the two last have been studied in such a manner as to allow of the devising of various technical methods for ensuring to plants the necessary amount of water and nutritive substances. As regards light, heat, and air, these are factors outside our sphere of influence and can be but little modified by cultural technique. In the case of the air, however, this assertion only holds good for the aerial parts of the plant, since for the normal development of its root system and the chemical and biological processes continually going on in the soil, oxygen is indispensable. It is thus evident that the conditions guaranteeing the presence of sufficient air for the plants can only be obtained by the help of an active exchange between the gases contained in the soil and the air.

These circumstances necessitate our studying the conditions which assure to plants the presence of sufficient oxygen in the soil, and to the technical means for preserving an active gaseous exchange in the soil. But, since research on the composition of the air in the soil has hitherto furnished data relating almost exclusively to its content of carbonic acid and of some other gases, and since, further, there is no connection between the amount of carbonic acid and that of the oxygen in the air of the soil, the method of indirectly determining the oxygen cannot be applied. Experiments have therefore been based on the direct estimation of the oxygen in a given volume of air corresponding to a determined volume of soil.

A special apparatus has been made for taking soil samples, and the whole apparatus for the study of soil aeration consists of a mercury pump, some small graduated tubes and a series of absorbents of the various gases.

In summarising the most important results of the experiments carried out by the writer, especial consideration will be given to those relating to the different types of fallow land, as the question of the most appropriate type is of paramount importance to Russia.

As a matter of fact the Agricultural Stations have been able to establish, after a considerable amount of research, that the so-called black fallow and the April fallow ensure the best crop of winter cereals. Further, the experiments made by the Agricultural Stations of South Russia have shown that there exists a definite connection between the manner of working the fallow and the humidity of the soil; while a series of recent experiments clearly show the importance of the date of beginning to work the fallow in connection with the accumulation of nutritive substances.

Equally important is the working of the fallow land in order to ensure the most efficient æration of the soil, and in connection with the related physical, chemical and biological processes.

The experiments were carried out on 4 types of fallow, viz., the so-called black fallow (the working of which begins in autumn), the April fallow and the two June fallows of which one, the "peasant" fallow, is characterised by having a soil much trodden by the cattle that the peasants usually put to graze upon it; the other is left unworked until June.

The results of the experiments are given in the adjoining table.*

In analysing this table it is seen that the black fallow soils and the April fallow soils always contain larger quantities of air and oxygen in comparison with the other types of soil studied; this was especially the case during the first experimental period which lasts from the beginning of working the soil until the time of sowing. As regards the modifications in the amount of oxygen in the soil of the different kinds of fallow, it appears that they are least in the case of the black fallows and April fallows and greatest in the June and peasant fallows.

Further, it may be stated that the æration of the soil becomes less and less in proportion as the soil becomes more compact and that every fresh working of the fallow makes the soil looser and increases æration, giving a new impetus to the gaseous exchange between the soil and the atmosphere.

In continuing the analysis, it is also noticeable that the consolidation of the soil takes place more suddenly in the best worked fallows, but nevertheless their air and oxygen content is always higher, especially in comparison with the peasant fallows. The amount of oxygen in 1 litre of soil varies in the following manner:—

Black fallow	59—81·5 c.c.
April ,, ...	63—81·4 c.c.
June ,, ...	52—65·2 c.c.
Peasant ,, ...	32—48·0 c.c.

In order to show better the difference between these various kinds of fallows, the data are given relating to the amount of oxygen found on August 1, i.e., at the time of sowing. Taking the oxygen content of 1 litre of black fallow soil as 100, that for the corresponding amount of April fallow soil is 107, in the case of the June fallow 86·5 and in that of the peasant fallow 54·2.

Thus, by working the fallow well, it is possible to ensure to the plant, towards the time of sowing, and throughout the autumn, a sufficient quantity of air. The June fallow differs from the black and April fallows during the first half of the summer; it approaches them in autumn, outstripping the peasant fallow, which is characterised by a low oxygen content during the whole of the summer.

After having established these differences in the oxygen content of different kinds of fallow, the writer, wishing to ascertain the influence of the winter season, made the necessary experiments on soil under rye, obtaining the following results (the soil samples were taken on April 24):

	C.C. in 1 litre of soil Air.	Oxygen.	Oxygen per cent. of air.
Black fallow under rye	238	45·9	19·3
April ,, ,,	232	45·4	19·6
June ,, ,,	224	43·5	19·0
Peasant ,, ,,	118	24·0	20·3

As is seen, the oxygen content drops to the level characterising the fallow soils on which the work has not yet been begun. The supplies of oxygen obtained by working the fallow can thus only be used by the plant during the

* Not reproduced.

autumn, since towards spring they become very small. Further, the differences observed at first between the 3 types of fallow disappeared almost entirely towards the spring, the peasant fallow alone, as before, having the lowest oxygen content.

The above-mentioned results of the study of the æration of fallow soils do not yet afford sufficient data to solve the problem of æration considered as a factor of the greater productivity of black fallow and April fallow soils, but they allow us to conclude that the differences in the reserves and in the composition of the air in the soil recorded during the experiments determine differences in the progress of the biological processes in the soil, which, working as a whole, give rise to the most favourable conditions for winter cereals. Considered from this point of view, the study of the æration of the soils of fallow land is as important as that of the movement of water in the soil.

The writer also made experiments on soils under summer cereals and on a number of factors influencing the composition of the air contained in the soil. Amongst these he studied: (a) the temperature; (b) the diffusion of gases in the soil; (c) the percolation of water in the soil; (d) the removal by wind of the air in the soil; (e) the formation of certain gases in the soil; (carbonic acid and other gases).

The outstanding fact is that of all the factors concerned in gaseous exchange, the percolation of water is the most active, but it only occurs during periods of rain. Thus, rapid changes in the composition of the air contained in the soil are only possible when it rains.

At the close of this article the writer gives full details of the method for determining the æration, porosity and absorptive capacity of the soil.—BULL. OF INT. INST. OF AGRIC.

INFLUENCE OF TILLAGE AND MANURES.

The maintenance of the soil in a high state of fertility is an essential condition of success in farming, in which respect the land does not differ greatly from the animals which feed upon it. The owners of racehorses and the exhibitors of cattle or sheep know that a long course of careful preparation, in which knowledge of the subject and skilful application are combined, is necessary to attain the object in view. It may be impracticable to treat the soil with the same regard to final detail, but the principle is the same. Bountiful crops cannot be raised by spasmodic methods, but they can be made reasonably assured by keeping the land in what the former calls "good heart," a term that conveys much to the practical mind.

Fertility can be preserved or encouraged in two ways—by efficient cultivation and the judicious use of manures. A third method might be mentioned, that of bare fallowing, which is still unequalled for handling the stronger clays and loams, but there will be little disposition voluntarily to adopt this course in the present crisis, the prevailing opinion being that all cultivable land should be made to contribute something to the needs of the nation.

The influence of good and seasonable cultivation can scarcely be overestimated. There is stored up in most land that has been long under the plough reserves of nutriment that can be made available as plant food through physical rather than chemical intervention. When the balances of constituents that make up the food of plants is considerably disturbed the use of chemical correctives may be essential, but it is astonishing what good tillage can do to cure disorders of the soil and to release nutriment formerly inaccessible. Systematic trials have been instructive on this point and evidence equally convincing is presented in the success of those who manage their holdings on this principle. The strong furrow noticeable in autumn tillages is the visible embodiment of the system. Much depends on the exposure of the soil to the full depth of its "improved" area to the ameliorating action of the winter forests.

SOMETHING THE ANCIENTS KNEW.

The use of vegetable and other fertilizers goes hand in hand with good cultivation. Practice and science are agreed that the manure heap is the chief source of fertilizing ingredients. The qualities of yard manure are no new discovery. Farmyard manure has been a vital element in preserving the productive capability of soils for countless generations. Its properties were as highly appreciated 2,000 years ago as they are to-day. This recognition is the root of the success of the industrious French peasants, who last month, undeterred by the absence of men and by depleted teams, were giving to their well-tilled plots the customary liberal top-dressing of manure, the work being done largely by women. The carting of manure is also a prominent source of employment in this country, but here more than in France, there is evidence that work has been restricted from want of labour. If this continues and the land be asked to respond to the national appeal, insufficiently aided by fertilizers, the result can scarcely fulfil expectations. The application of artificial manures is simple, but it cannot compensate for the absence of dung, which is almost as valuable for its equalizing and physical influence as for the nutriment it adds directly to the soil.—THE TIMES.

EXPERIMENTS ON THE APPLICATION OF SULPHATE OF AMMONIA.

L. MALPEAUX.

The soil chosen for these experiments was a uniform loam in good condition, which had been dug two spits deep. At the beginning of April the writer marked out six adjacent rectangular plots, which were then dressed as evenly as possible with sulphate of ammonia at the rate of 360 lb. per acre dug in at varying depths from 2 to 12 inches.

A portion of the same side of each plot was reserved without crop and the whole of the remainder sown with sugar-beets. The thinning out was carefully done so as to leave the same number of plants in each plot. Samples of soil were taken to a depth of 16 in. simultaneously in both cultivated and bare ground on June 30, July 31, and August 29, and the percentage of nitric nitrogen was determined by the colorimetric method.

The detailed results of these analyses are summarised as follows:—

On bare land the variations are of small extent in the control plots, which only yielded for determination nitrates resulting from the nitrification of humus in the soil. The maximum figures occur in the zone from 4 to 8 in. and from 8 to 12 in. The same result was also found in all plots where the manure was buried. Where sulphate of ammonia was applied as a top-dressing the greatest proportion of nitric nitrogen remained in the upper 4 in., a circumstance which is obviously unfavourable to its rational use by a tap-rooted plant like the beet. The results for the total amount of nitric nitrogen of each plot receiving nitrogenous manure agree sufficiently to show that in no case was there any loss of nitrate. Even where the sulphate of ammonia was not most deeply buried, the maximum amount of nitrate is found in the zone between 8 and 12 in. deep. Thus the combined influences of rain and capillarity cause the ascent of soluble manure towards the surface.

Since the manure did not leave the 16 in. layer, the variations in the total amount and proportions of nitric nitrogen for each plot of beets can only be due to the absorption by plants. Consequently the differences in the figures of corresponding plots in bare soil give a measure of the relative quantities of nitrogen consumed by the plants. Whilst the control plot was only able to supply 5 mgms. of nitric nitrogen per 100 mgs. of dry earth, the manure had provided 6·8 when applied as a top dressing, 7·7 when buried at a depth of 2 in., 9·5 at a depth of 4 in., 8·8 at 7 in., and 9·1 at 12 in. It is thus easy to see that the best use of the manure is obtained by burying to a depth of at least 4 in.

This conclusion is supported by the results of the weighing and analysis of the roots from each plot, as shown in the following table:

No. of plot.	Sulphate of ammonia applied at:	Yield in cwt. per acre.		Density at 15°C.	Percentage of sugar in juice.	Purity.	Percentage of sugar in roots.	Yield of sugar per acre.
		Leaves	Roots					cwt.
1.	Control	282	226	7·4	16·87	86·8	14·53	32
2.	Surface	469	274	7·0	15·54	84·5	13·52	37
3.	Depth of 2 in.	457	282	7·1	15·90	84·7	13·81	39
4.	,, ,, 4 ,,	465	389	7·4	16·23	82·8	14·07	55
5.	,, ,, 7 ,,	471	358	7·1	15·98	85·0	13·88	50
6.	,, ,, 12 ,,	477	356	7·2	16·55	86·9	14·36	51

The manure applied as a top-dressing or simply dug in to a depth of 2 inches was later in action than in the other plots. Growth was prolonged and there was a predominance of leaf development over that of the roots, especially in the autumn. The greatest yield was obtained with manures dug in to a depth of 4 inches, but the results of the plots dug to a depth of 7 and 12 inches were also very satisfactory.—BULL. OF INT. INST. OF AGRIC.

ENTOMOLOGY.

SHOT-HOLE BORER OF TEA.

DISCUSSION AT THE COMMITTEE OF AGRICULTURAL EXPERIMENTS, PERADENIYA, NOVEMBER 11, 1915.

MR. SPEYER gave the results of some experiments to illustrate the relation of the attack of Shot-Hole Borer Beetle to the general conditions under which Tea is cultivated in Ceylon.

These experiments had, for their basis, observations made while gathering information on estates in the Province of Uva, a district, therefore, to which the results must have their limit on application.

These were :—

(1.) In fields which have run 2–6 months from pruning, the number of trees attacked by Shot-hole is almost negligible, whereas there is an increase in the number of trees infested for the ensuing months up to the time of pruning—for instance, at the end of two years from the last pruning.

(2.) Without exception—as far as experience has gone—there are always some trees left unattacked at the end of two years, no matter how severe the attack in surrounding individual bushes may be at the time.

(3.) A definite, and sometimes rapid, increase of attack results in fields which have run 10–16 months from pruning, at a time, more or less coinciding with the pruning of fields which have run 2 years. To afford reasons for these observations, three experiments were performed on a similar line of procedure, where a number of trees were selected, surrounded on all sides by tea-bushes containing shot-hole borer. In all three, a portion of a field was selected, containing a known number of bushes. The bushes were examined and a record taken of those bushes which were infested. From the latter, in Experiments 1 and 2, all beetle galleries, contained by the bushes, were removed and the area exposed to further attack by beetles flying from the surrounding tea, for a known period of time. At the end of this period, the same process would be repeated, and the area likewise left exposed to attack for another period, and so on, as shown in the two tables given.

In Experiment 3, however, instead of removing the shot-hole borer, the bushes were pruned, not with a view to removing the beetle-galleries, but with a view to ensuring the out-put of shoots within a reasonable space of time. A bush thus pruned in one period would often contain a number of entrance holes in the collar. These holes were counted at the end of each period, in each bush containing them, and if more holes were present in one period than in the period preceding, this bush was marked down as reinfested. If, on the other hand, the same number of holes were found, then the bush was marked as left unattacked during that period.

Experiment 1. Number of trees used for experiment, 257 : bushes, large ; health, good ; ground, level ; elevation, 2,800 ft. Pruned last, July 1913. Due for pruning, July 1915. Experiment started 21 months from previous

pruning; 3 months from future pruning.

Period.	Duration Days.	Trees attacked.	Trees revisited.	Trees newly attacked.	Trees previously attacked left unattacked	Trees never attacked previously.
To April 24 ...	—	93	—	—	—	164
1. April 24-May 8...	14	77	58 (75 %)	19 (25 %)	35	145
2. May 8-May 28...	21	70	54 (77 %)	16 (23 %)	58	129
3. May 28-June 18	21	61	46 (75 %)	15 (25 %)	82	114
4. June 18-July 1 ...	14	66	57 (86 %)	9 (14 %)	87	105 (40 % of total

Experiment 2. Number of trees used for experiment, 41 : bushes, small; health, poor; ground, sloping steepily; elevation, 4,300 ft. Pruned last, August 1914. Due for pruning, August 1916. Experiment started 11 months from previous pruning; 13 months from future pruning.

Period.	Duration Days.	Trees attacked.	Trees revisited.	Trees newly attacked.	Trees previously attacked left unattacked	Trees never attacked previously.
To July 12 ...	—	10	—	—	—	31
1. July 12-20 ...	8	9	6 (69 %)	3 (31 %)	4	28
2. July 20-28 ..	8	11	6 (54 %)	5 (46 %)	7	23
3. July 28-Aug. 8...	10	6	3 (50 %)	3 (50 %)	15	20
4. Aug. 8-Oct. 14...	57	13	7 (54 %)	6 (46 %)	14	14
5. Oct. 15-30 ...	16	7	7 (100 %)	0 (0 %)	20	14 (34 % of total

These two experiments show clearly that :—

(1) Shot-hole borer beetle, either by instinct or the process of trial and error, attacks trees which have previously been the subject of attack.

(2) A number of trees (in Experiment 1, 40 %) are never visited by the beetle.

The results lead one strongly to believe that the bushes gradually attain a state in which they invite attack the longer they run from the last pruning, and that some bushes hold out against the beetle longer than others; a considerable number, indeed, for the whole period between two prunings, 2 years on good soil, and a smaller number on poor soil.

The figures of Experiment 2 are not so striking as those of Experiment 1 for two reasons, namely, that the number of trees used was much smaller, and the bushes, being smaller, in some cases at any rate, presented the

appearance of having been pruned in the later periods, owing to the number of branches which it was necessary to remove in extracting the shot-hole galleries. The latter point, however, acts to a considerable extent in confirming Experiment 3.

It is established, then, that an immunity exists in the tea-bush, which is lost sooner by some bushes than by others after pruning.

The next experiment shows the exact effect of pruning upon thus rendering the trees immune for a certain period of time.

Experiment 3. Number of trees used for Experiment, 41: bushes as in Experiment 2, and adjoining the same.

In periods 1 and 2, bushes merely pruned when found infested.

In periods 3 and 5, bushes treated as in Experiments 1 and 2.

Period.	Duration Days.	Trees attacked.	Trees revisited.	Trees newly attacked.	Trees previously unattacked.	Trees never attacked unpruned.
To July 12 ...	—	11	—	—	—	30
1. July 12-20 ...	8	7	4 (57 %)	3 (43 %)	7	27
2. July 20-28 ...	8	7	0 (0 %)	7 (100 %)	14	20
3. July 28-Aug. 8...	10	12	2 (17 %)	10 (83 %)	19	10
4. Aug. 8-Oct. 14...	57	5	2 (40 %)	3 (60 %)	28	7
5. Oct. 14-Oct. 30	16	2	2 (100 %)	0 (0 %)	31	7 (17 % of total

It will at once be recognised that, as compared with the last two experiments, the proportion of trees revisited to those newly attacked in each period is practically reversed, except in the last two Periods, where the bushes received the same treatment as in the first two experiments.

This means that the pruned bushes, instead of inviting attack after the first infestation, attained an immunity similar, perhaps, to that exhibited by 40 % and 37 % respectively of the trees in Experiments 1 and 2. The exact effect of this pruning is best shown by reference to the column of figures in each Experiment indicating the number of trees in each period which were left unattacked after having been infested in a preceding period. To illustrate this, the proportion of these trees to those revisited is given in percentages.

In Experiment 1.

Period.	Trees revisited.	Trees previously attacked left unattacked.
1. ...	62 ...	38
2. ...	49 ...	51
3. ...	36 ...	64
4. ...	40 ...	60

In Experiment 2.

1.	60	40
2.	47	53
3.	17	83
4.	34	66
5.	26	74

In Experiment 3.

1.	36	64
2.	0	100
3.	10	90
4.	10	90
5.	9	91

In Experiment 1 and 2, the figures are strikingly similar, the proportions becoming gradually reversed owing to there being a greater number of trees attacked once or more in each successive period (for instance in Exp. 1. Before Period 1. 93, in Period 1. 93 + 19 = 112, and so on), thus providing a bigger choice in each instance.

In Experiment 3, on the other hand, the preponderance of trees left unattacked over those revisited is remarkable, and is merely due to the effects of pruning. Those trees which had been pruned before Period I. began to give best evidence of their immunity about the time of Period 3., when the shoots were putting out an abundance of leaves, and at the end of the experiment, which had lasted 3½ months, 100% of the pruned trees had become immune, even though the galleries of the beetle had not been removed from them, save in the branches.

At the beginning of the Experiment, however, the effect of the pruning, on the trees first found attacked, had not made itself apparent.

An examination of the 257 trees of Experiment 1, made on October 24th—4 months after natural pruning—showed not a single beetle present in any of the bushes, and evidence is forthcoming, but must be deferred, that the beetles are actually forced to leave their galleries in the lower parts of the bushes after pruning.

In those branches which put out no shoots after pruning, however, this is not the case. It is therefore highly advisable to remove these branches from a field within 4 months after pruning.

Finally, tea grown under exceptionally poor conditions does not seem to conform to an establishment of immunity to the extent which is noticeable in healthy, well-manured fields.

The exact causes which produce this immunity will form the subject of a future report, if, indeed, it will be found possible to give a satisfactory explanation of them.

Note—The above differs somewhat from the account actually given by MR. SPEYER at the meeting but the figures are exactly the same though the interpretation of them is simpler, and the conclusions drawn from them remain the same as those actually given at the meeting.

MR. WILKINS asked MR. SPEYER if he had any idea as to why certain bushes or parts of fields appeared to be immune? Whether rainfall or manure had any influence?

MR. SPEYER replied that the actual reason for immunity was not at present possible to give, but that natural immunity might well be the same as that produced by pruning, therefore in which case a mere increase in the flow of sap might be the cause of such immunity. At the same time, manuring and sap-flow must be closely co-ordinated as a general outcome of the health of the plant.

MR. COOMBE said that he thought this season had been an unfortunate one for MR. SPEYER's experiments owing to the unusual and continued wet weather—no prolonged drought having been experienced.

MR. SPEYER defended the result of his experiments on the ground that they were comparable within themselves.

MR. COOMBE thought that the point that those branches that did not sprout after pruning and which generally died, almost invariably contained beetles, was an important one. Something might be done by cutting these out and burning them.

MR. SPEYER said that his method had been originated by MR. D. S. CAMERON and put into practice with good results.

MR. PATTERSON asked MR. SPEYER his opinion as to hard pruning at long periods as compared with lighter pruning at shorter periods?

MR. SPEYER replied that he strongly deprecated hard pruning of any kind with intent to get below the beetle galleries. The immunity produced by a pruning suitable to the requirements of the bush, was entirely sufficient to produce a temporary immunity. A hard pruning on a bush which did not require it, was therefore defeating the object in question.

MR. TISDALL asked if the beetles were found only in the branches.

MR. SPEYER replied that they were also found in the stem and even in the stem under the ground, but not in the roots.

MR. COOMBE enquired whether MR. SPEYER had arrived at any conclusion as to the burning of the prunings.

MR. SPEYER replied that at present he would advocate half measures, that is slashing off the green leaves and light twigs which do not generally contain beetle, to be returned to the soil as humus and burn the stems which form the principal home of the borer. But he would like to enquire whether this was practicable.

MR. HUYSHE ELIOT replied that this was the common practice on some estates where the cost worked out at about Rs. 2 per acre.

MR. WILKINS strongly opposed burning prunings as it robbed the soil of valuable humus. In his opinion high cultivation would give a good yield in spite of borer.

MR. SPEYER strongly supported the latter part of MR. WILKINS' remark.

MR. T. Y. WRIGHT said he had collar-pruned a field badly infected and burnt all the prunings, with the result that there was an excellent flush and only a little borer to be found.

MR. SPEYER intimated that similar results might have been obtained by less drastic measures.

COCONUT BEETLES.

MR. F. W. URICH, in a paper read before the Agricultural Society of Trinidad, enumerates the different beetles attacking the coconut palm.

Oryctes rhinoceros, the rhinoceros beetle of the East occurring in Ceylon, India, the Dutch East Indies, Philippines, Samoa, Straits Settlements and F. M. S., which in the adult stage attacks the palm for food, boring into it through the central bud, feeding on the soft tissues and also paving the way for other insects as well as fungi.

Other species of Oryctes occur in Madagascar and Africa and work in the same way.

In the West Indies *Strategus alœus* is the chief beetle pest of young coconuts. The adult burrows in the ground, enters the palm from below and works up to the tender tissues of the bud.

S. julianus is another species which attacks pineapples.

Phileurus aidymus has been observed on trees which have succumbed to budrot.

Enema endymion is said to attack coconut palms like Strategus alœus.

Parselus internuptus is described as a scavenger pure and simple, living in decaying wood of any kind.

RICE PESTS.

1. THE RICE WEEVIL *(CALANDRA ORYZÆ.)*

This small weevil belongs to the order Coleoptera or the Curculionid family. It is considered as being indigenous to the East whence it has spread all over the world. It causes great damage to cereals such as rice, wheat and maize.

Life History.—The adult measures 3 to 4 mm. in length and 1 mm. in width and varies in colour from deep brown to ferruginous brown. The elytra are adorned with four distinct reddish spots situated obliquely at its base and tip; these spots, however, are sometimes missing or feebly indicated.

The body is densely punctured: the elytra are deeply striated longitudinally and loosely covered with short, rigid and yellowish hairs.

The head which is as big as the thorax is prolonged into a sort of snout.

The antennæ are elbowed and longer than the proboscis.

The larva is a small white grub, fleshy, wrinkled and legless, and is as long as it is large. The chrysalis or nymph is also white and transparent and exhibits the general characteristics of the adult insect.

By means of her rostrum, the female bores a small hole in the grain where she lays one egg. Several eggs are laid, as a rule, in the maize grain as it contains sufficient food for several larvæ.

A few days after they have been laid, the eggs hatch out and the young larvæ eat their way through the grain, which is soon reduced to dust. When they are full-grown, the larvæ measure 2 to $2\frac{1}{2}$ mm. long and change to the nymphal state, during which period the ultimate transformations take place.

The adult insect can live a long time, varying from three to five months according to season and climate, and is on account of its longer period of life much more injurious than the larvæ.

In this colony, the evolution of this species lasts about 30 to 40 days; it is shorter in summer than in winter and varies with localities. The number of generations annually produced varies from 6 to 8 on the sea coast; on the higher districts, it is probably less.

This weevil is not peculiar to rice as its name seems to imply. Although it is very common in both rice and maize, it is not less injurious to all cereals and has even been commonly recorded as being injurious to various foodstuffs such as macaroni, biscuits, etc.

The weevils reared from rice are as a rule smaller and of a lighter colour than those from maize. The yellowish red spots on the elytra are not so often missing.

Rice often arrives from India infested with this weevil. It is not uncommonly considerably damaged and rapidly becomes unfit for consumption.

Remedial Measures.—No serious attempt has ever been made up to the present for ridding buildings in which rice is stored of this pest. The insects are to be found swarming on the bags and crawling over the walls.

A thorough treatment with either carbon bisulphide, hydrocyanic gas or sulphur dioxide would necessitate the opening of the bags, the spreading of the grain in thin layers on the flour and its repacking. These operations, which would have to be repeated at least twice yearly, would necessarily entail an expenditure that would not be recouped if the losses the merchants have been used to consider as unavoidable are taken as the basis for calculation.

The disinfection carried out by the Medical Department against rats by means of sulphur dioxide generated by a Clayton apparatus has, however, given excellent results, and if it were frequently repeated it would undoubtedly reduce considerably the damage done by this insect.

Owing to local conditions, such as situation of the stores in the commercial centre of the town, the narrowness of the stores when compared with the enormous quantities of grain they contain, and the different varieties of grain in sewn bags, which render carbon bisulphide and hydrocyanic gas treatments very expensive, the sulphur dioxide gas method seems to be the most practical and economical one in spite of the limited penetration of the gas.

II. THE RICE MOTH (*EPHESTIA CAHIRITELLA.*)

This insect is a small moth of the family of the Phycitidæ and is spread all over the world.

In India, where it is extremely common, it attacks especially rice and flour. In Egypt and in America, where it has been named the dried-currant moth, it attacks most of the dried fruits, such as raisins, currants, and figs. It also attacks almonds, nuts, and cacao-beans. In this country it has a marked liking for the white Saigon and Rangoon rices. Other kinds of rice are seldom attacked.

Life History.—At rest the wings are folded round the body; when expanded, they measure about 20 mm. The fore-wings which are much narrower than the hind ones, are lead grey in colour with more or less suffused brown markings, more conspicuous on the longitudinal veins. The hind wings are of a uniform dirty white colour and are bordered with a large fringe of the same colour. The whole body is grey.

The caterpillar measures from 10 to 12 mm. ; it varies from dirty white to yellowish and bears on its segments short and rigid hairs. It lives inside a sort of silky sheath made of spun-up grains in which it spends its whole life.

The chrysalis measures 8 to 10 mm. ; it is reddish brown and is enclosed in a white silky cocoon.

These insects are not only injurious on account of the quantity of grains they consume, but specially on account of the unsaleable state to which they reduce the grains, as they leave in it their excreta, their nymphal envelopes together with the spun-up grain.

The removal of this waste is a laborious operation which entails much labour and necessitates an expenditure much above the cost of the actual damage done by the insects themselves.

Remedial Measures.—The moths are to be found resting on walls and on the bags of the stores, where they can be easily destroyed by carbon bisulphide or any other insecticide.

The refuse coming from the infected rice, which always contains live larvæ and chrysalides and eggs, should not be simply thrown away. It should always be carefully burnt. Repeated applications of carbon bisulphide, and destruction of all refuse, would rapidly get rid of this pest and the expenditure involved would not be great.—BULL. NO. 2, DEPT. OF AGRIC., MAURITIUS.

FOOD OF AZOTOBACTER.

F. L. MOCKERIDGE.

In order to discover how far *Azotobacter* is capable of utilizing the wide range of organic compounds which occur in soil, cultures of the organism were inoculated into series of media made up of various organic substances and mineral salts. The organic substances in question included humates, polysaccharides, sugars, alcohols, the calcium salts of organic acids, esters, glucosides and benzine derivatives.

In the case of the humates, growth was only obtained when the organic matter was supplied as ammonium humate and no nitrogen was fixed. The availability of the glucosides was restricted somewhat by the products of their decomposition, and the benzine derivatives proved totally unable to provide a source of energy for *Azotobacter*. The presence of either of these two latter classes of compounds, however, never inhibited growth on manitol-agar plates. The carbohydrates tested showed themselves in general to be readily available sources of food for *Azotobacter*. The returns of nitrogen fixed for the expenditure of food material varied considerably and the rule seemed to be that the longer the time taken to use completely a unit mass of the nutrient, the less nitrogen was fixed upon that medium.

Considering the wide range of compounds which *Azotobacter* proved itself capable of assimilating, it is evident that any ordinary soil must contain abundant food material for the growth of the organism.—BULL. OF INT. INST. OF AGRIC.

GENERAL.

CEYLON AGRICULTURAL SOCIETY.

MEETING OF 30TH NOVEMBER, 1915, AT GALLE.

Minutes of a meeting of the Board of Agriculture held at Galle Kachcheri, on Tuesday the 30th November, 1915, the Hon'ble the Government Agent (Mr. R. B. Hellings) presiding.

There were also present :—Mr. R. N. Lyne (Director of Agriculture) Mr. M. Kelway Bamber (Government Agricultural Chemist), Mr. D. S. Corlett (Manager, Experiment Station, Peradeniya), Mr. L. E. Campbell (Rubber Research Chemist), Mr. G. M. Henry (Asst. Government Entomologist), Mr. Geo. Bryce (Acting Botanist and Mycologist), Mr. T. H. Parsons (Curator, Royal Botanic Gardens, Peradeniya), Mr. B. F. Scherffius (Tobacco Planter), Very Rev. Father J. Cooreman, S.J., Rev. Father Paul Cooreman, S.J., Mr. Paul E. Pieris, Dr. E. Ludovici, Dr. J. B. Lourensz, Mr. and Mrs. R. L. Ephraums, Mudaliyars J. P. Goonetilleke, E. B., Goonetilleke, O. Tillekeratne, Harry Jayawardene, E. V. Gooneratne, T. W. Goonewardene, H. D. Perera ; Proctors M. S. Gooneratne and D. W. Subasinghe ; Messrs. H. Amarasuriya, N. A. S. Jayasuriya, T. W. Goonewardene, Jnr., T. P. Abeyewickreme, E. L. Daniel, President P. B. Herat, and a large number of headmen from the Wellaboda, Gangaboda and Talpe Pattus, as also headmen of the Gravets, and the Secretary (Mr. C. Drieberg).

A meeting of the Committee of the Board was held prior to the meeting of the Board at which Mr. Corlett brought up the subject of the advantages of the Drain and Canal system of paddy cultivation as a means of controlling the water supply. Considerable discussion ensued.

The meeting of the Board followed. The Secretary read the Minutes of the meeting held on 25th May, 1915, at Kandy, which were duly confirmed.

Progress Report for the quarter ending November was read and adopted.

Statement of Expenditure to end of October was tabled.

At the Meeting of the Society which followed Mr. Amarasuriya read his paper on "Notes on Coconut Cultivation in the Southern Province." In the course of the discussion which followed Mr. Bamber said the idea that artificial manure exhausted the soil and shortened the life of the tree was fallacious. Intelligent manuring on the other hand lengthened the life of a tree. Mr. Paul Pieris and Mudaliyar Goonetilleke also offered remarks.

Mr. Scherffius read a short note on Tobacco : Estimates, Profits, Yields, etc., for Ceylon. Mr. Paul Pieris and Mr. Amarasuriya joined in the discussion which followed.

The Director in summing up the proceedings advised that one or two young men should be sent to study the methods adopted at the Tobacco Station, so that the Southern province may benefit by the knowledge acquired by them. He said that paddy experiments on the lines followed by Mr. Corlett will be demonstrated at Hambantota. He invited some of those present to visit Jaffna to see the work that is going on there.

A vote of thanks to the chair terminated the proceedings.

C. DRIEBERG,
Secretary, C.A.S.

HORSE FOOD.

THE HORSE AND MECHANICALLY DRIVEN VEHICLES.

In many parts the horse still holds its own against mechanically driven vehicles. The initial cost and the uncertainty of cost of upkeep along with an ignorance and fear of mechanics keeps many from taking the initial step in changing their mode of locomotion from oats to petrol. Where roads are poor, jungle tracks and rough country have to be traversed, the horse is supreme; such conditions obtain on many estates, where, if supervision is to be thorough the horse is necessary. The horse can go most places cars and cycles cannot. The recent riots showed up the immobility of car and cycle, where bridges were destroyed; and other methods could have been used to render mechanically driven vehicles still less mobile. Under these conditions, districts could have been isolated and devastated by the mob; valuable estates and properties which had cost the owners much capital could have been ruined long before military aid could have been obtained. The only saviour of such an imaginary situation would have been mounted troops, whose mobility is difficult to destroy. They go like water, anywhere. If such situations are to be avoided Government will require a certain number of horses to be kept in the Island for military purposes. The horse has by no means passed its usefulness, and if stables are to be kept it is necessary to consider the cheapest and best method of feeding, to regulate stable account.

CAUSES OF RISE IN PRICES.

A comparison of prices of horse food pre-war days with the prices regulating now shows there has been a marked increase of price. The war has closed down ports and markets, monopoly by Governments have come into existence as with other produce, shortage of freight has raised the cost of carriage, and embargoes made by countries to preserve their supplies have all tended to raise the price of horse-food.

Table 1.

VOLUME, WEIGHTS AND PRICES.

No.	Name of Sample.	Weight grams.	Weight lb	lb. Meas.	No. of Measures per bag of 108 lb.	Price per bag 1915.	Price per bag 1912.	Increase % in Price.
1	One cut. Measure Gram whole	814	1·97	100=50·7	55	Rs. 8·00	Rs. 6·50	23·08
2	,, ,, ,, ,, crushed	676	1·49	,, =67·0	72	,, 8·25		
3	,, ,, ,, Paddy whole	630	1·53	,, =65·3	72	,, 6·35	,, 6·00	5·83
4	,, ,, ,, ,, crushed	493	1·2	,, =83·3	90	,, 6·60		
5	,, ,, ,, Australian Oats whole	541	1·31	,, =76·3	79	,, 15·00	,, 8·75	71·43
6	,, ,, ,, Australian Oats crushed	349	0·84	,,=119·0	128	,, 15·25		
7	,, ,, ,, Indian oats whole	488	1·18	,, =84·7	89	,, 10·00		
8	,, ,, ,, Indian oats crushed	316	0·77	,,=130·0	138	,, 10·25		
9	,, ,, ,, Australian Bran	225	0·54	,,=185·0	193	,, 12·35	,, 6·50	90·00
10	,, ,, ,, Indian Bran	200	0·48	,,=208·0	216	,, 7·00	,, 5·50	27·27
11	,, ,, ,, Australian Chaff	163	0·39	,,=250·0	*215	,, 11·00		
12	,, ,, ,, Indian Chaff	97	0·23	,,=435·0	*366	,, 6·50		

* 84 lb. bags.

N.B.—1 Bushel=8 gallons=32 Quarts (or Measures) 1 Measure full of water weighs 2½ lb. nett.

CRUSHED AND UNCRUSHED FOODS.

On looking over the above table it will be noticed that crushing gram reduces the weight of a measure by 25%, paddy by 20%, Australian oats by 33%, Indian oats by 35%. So that if crushed food is ordered, the ration should be increased by that proportion for the several foods to make it up to the uncrushed material. Where long distances have to be covered from merchant to stable, uncrushed food will be the easier to handle in carriage but should be crushed before using, to facilitate digestion.

INDIAN AND AUSTRALIAN FOODS.

Comparing Indian material with Australian, it is noted that Indian food is lighter than the Australian. Indian Bran is 10% lighter than Australian Bran, Indian Chaff is 40% lighter than Australian Chaff, Indian Oats is 10% lighter than Australian Oats. To get the equivalent weight of Indian food to Australian food, the Indian food must be increased by the above proportion for the several foods.

PRESENT PRICES.

Comparing the prices in above table, it will be seen there is an increase of from 6-90% in price and that the greatest increase is on Australian produce, especially Oats and Chaff.

VALUE OF A FOOD.

The value of a food can be deduced from an analysis, true value for the individual animal by trial. A table of food and analyses are given below:—

Table 2.
HORSE FOOD ANALYSIS.

Australian Bran		Indian Bran	Australian Chaff	Indian Chaff
Moisture	13·5 %	13·0 %	14·0 %	11·0 %
Ash	4·7 ,,	6·0 ,,	3·9 ,,	10·3 ,,
Oil	2·8 ,,	2·9 ,,	4·3 ,,	1·8 ,,
Woody-Fibre	8·3 ,,	10·8 ,,	22·0 ,,	29·4 ,,
Proteids	13·5 ,,	13·1 ,,	7·1 ,,	2·2 ,,
Carbohydrates	57·2 ,,	54·2 ,,	48·7 ,,	45·3 ,,
	100·0	100·0	100·0	100·0
Nitrogen	2·16 %	2·1 %	1·13 %	0·35 %
Nutrient ratio	1:4·7	1: 4·6	1: 8·4	1:22·6
Food-units	97·95	94·2	77·2	55·3
Price per Bag 108 lb.	Rs. 12·35	Rs. 7·0	Rs. 11·0*	Rs. 6·50* (*84 lb.)
Price per Food-unit	Rs. 0·12	Rs. 0·07	Rs. 0·17	Rs. 0·14

	Australian Oats	Indian Oats.	Paddy	Indian Gram
Moisture	12·5 %	11·8 %	12·3 %	11·5 %
Ash	2·3 ,,	3·1 ,,	4·6 ,,	2·6 ,,
Oil	6·3 ,,	6·6 ,,	2·9 ,,	4·8 ,,
Woody-Fibre	8·7 ,,	14·9 ,,	8·6 ,,	6·8 ,,
Proteids	12·3 ,,	10·9 ,,	6·6 ,,	20·5 ,,
Carbohydrates	57·9 ,,	52·7 ,,	65·0 ,,	53·8 ,,
	100·0	100·0	100·0	100·0
Nitrogen	1·96 %	1·74 %	1·06 %	3·28 %
Nutrient ratio	1:6	1:6·3	1:10·9	1:3·3
Food-units	104·4	96·5	88·8	117·1
Price per Bag 108 lb.	Rs. 15/-	Rs. 10/-	Rs. 6·35	Rs. 8/-
Price per Food unit	Rs. 0·13	Rs. 0·10	Rs. 0·06	Rs. 0·06

Table 3.

COMPARISON OF UNCRUSHED FOODS IN FOOD-UNITS, WEIGHTS AND VOLUMES.

Proportion of Food-Units.	Weights in Lbs.	Weights in Lbs.
Paddy : Gram :: 88·8 : 117 1	100 Gram = 132 Paddy	100 Paddy = 75·7 Gram
Aust. Oats : Gram :: 104·4 : 117·1	100 Gram = 112 Australian Oats	100 Aust. Oats = 89·5 Gram
Indian Oats : Gram :: 96·5 : 117·1	100 Gram = 121 Indian Oats	100 Indian Oats = 82 2 Gram
Paddy : Aust. Oats :: 88·8 : 104·4	100 Aust. Oats = 118 Paddy	100 Paddy = 85 Australian Oats
Paddy : Indian Oats :: 88·8 : 96·5	100 Indian Oats = 110 Paddy	100 Paddy = 92 Indian Oats
Indian Bran: Indian Oats :: 94·2 : 96·5	100 Indian Oats = 102·4 Indian Bran	100 Indian Bran = 97·8 Indian Oats
Paddy : Indian Bran :: 88·8 : 94·2	100 Indian Bran = 106 Paddy	100 Paddy = 94·2 Indian Bran
Gram : Indian Bran :: 117·1 : 94·2	100 Gram = 124 Indian Bran	100 Indian Bran = 80·4 Gram

Volume in Measures.

100 Paddy = 59·2 Gram; 100 Gram = 169 Paddy
100 Gram = 168 Australian Oats; 100 Australian Oats = 61 Gram
100 Gram = 200 Indian Oats; 100 Indian Oats = 50 Gram
100 Aust. Oats = 101 Paddy; 100 Paddy = 99 Aust. Oats

Volume in Measures.

100 Indian Oats = 86 Paddy ; 100 Paddy = 117 Indian Oats

100 Indian Oats = 251 Indian Bran ; 100 Indian Bran = 40 Indian Oats

100 Indian Bran = 33·3 Paddy ; 100 Paddy = 300 Indian Bran

100 Indian Bran = 20 Gram ; 100 Gram = 505·7 Indian Bran

EXPLANATION OF TERMS, FOOD-UNITS, NUTRIENT-RATIO.

In the above table the various constituents may require explanation to the layman. The ash, less any sand there may be, is the bone-forming material, and is essential to the animal's welfare for the various salts required in building up the body and causing the organs to perform their functions properly. The oil or fat and carbohydrates are fat producing; the proteids are flesh forming; the woody fibre is the indigestible matter. The various complex bodies, simply expressed, are broken down by the animal's digestion process and elaborated by metabolism into flesh, bones, fat, blood, and heat or work in which so much is dissipated according to the amount of work done. Converting these various constituents into food units it is necessary to multiply the sum of the percentage of oil and albuminoids by 2·5, to obtain the carbohydrate equivalent, and add the figure obtained to the percentage of carbohydrates. Thus in Australian oats the total food units in 100 parts by weight are :—

Oil ...	6·3	Carbohydrate
Proteids ...	12·3	equivalent
	18·6 × 2·5 = 46·5	
+ Carbohydrates	57·9 = 104·4 Food Units	

If the various food units, per 100 lb., calculated above, be taken and the price per 100 lb. of food be also calculated, the price of I food-unit can be found. These are given above. On comparing the prices per 1 food-unit for the various foods it will be seen that the Indian foods are much cheaper per unit than the Australian foods. Indian bran is to the Australian bran as 7 : II in price per food unit ; Indian chaff is to Australian chaff as 14 : 17 ; Indian oats is to Australian oats as 10 : 13. That is taking into consideration the composition and the price; if the composition were taken into consideration alone the Australian food has per 100 lb. more food units, thus Indian Bran is to Australian Bran as 94·2 : 97·95, Indian chaff is to Australian chaff as 55·3 : 77·2, Indian oats is to Australian oats as 96·5 : 104·4. The cheaper Indian foods bring the price per food unit down to a cheaper food unit than that of the Australian food units.

To compare the various foods amongst themselves the ratio between the protein matter and the fat, starch, and sugars, etc., must be obtained ; this is called the "nutrient ratio" and is important along with the food-units in the study of foods. Take for example gram—the nutrient ratio is found by adding the carbohydrates to the carbohydrate equivalent of the fat (found by experiment to be fat × 2·5) and finding the ratio of the proteids to this figure obtained,

$$53·8 + 4·8 \times 2·5 = 65·8.$$

Nutrient Ratio. 20·5 : 65·8 : : I : 3·2.

A narrow ratio is where the ratio approaches I : 4, a broad ratio I : 8; the former ratio is used in feeding animals which are undergoing hard work, the latter where fattening of cattle is taking place for market purposes. The ratio I : 3 indicates a strong food containing much proteids in proportion to the fats

and carbohydrates and requires to be mixed with foods containing more carbohydrates and fats to reduce the ratio.

COMPARISON OF AUSTRALIAN AND INDIAN FOODS.

Australian Bran compares favourably with Indian Bran. It has less woody-fibre than Indian Bran but the nutrient ratio is practically the same and as the price is as 12 : 7 the price per food unit is more for Australian Bran, namely 12 cents, to the Indian Bran 7 cents; all is in favour of Indian Bran.

Indian Chaff is inferior in quality to Australian chaff, weight for weight, containing more woody-fibre and less of the feeding qualities, namely fat, proteids and carbohydrates, but still due to the cheaper rate charged for Indian Chaff, the price per food unit is less than that for Australian chaff. Indian Chaff as a food is poor, having a poor nutrient ratio. Referring to an old analyses of Ceylon Paddy straw it appears that it is superior to Indian chaff having a nutrient ratio of 1 : 17 and 57·4 food units per 100 lb., so chopped Paddy straw would be better and cheaper as a food filler or dilutant to the richer foods than Indian Chaff.

Indian Oats are inferior to Australian Oats having more indigestible matter, and less of the true feeding material. The nutrient ratio is similar. Indian oats are cheaper per unit. Comparing Indian Oats with Indian Bran it should be noted that the former has 96·5 food-units, the latter 94·2 food units, and the price is Rs. 10/- against Rs. 7/- for 108 lb. Considering the similarity between the number of food units and the difference in price it might be said that Indian Bran is a better food than Indian Oats. The price per food-unit is 7 cents in the case of the Bran, 10 cents in the case of the Oats.

Paddy has a broader nutrient ratio than oats, is lower in proteids and fat but richer in carbohydrates. The total food-units are less, 88·8 compared with Australian oats 104·4, Indian Oats 96·5; the price per food unit is 6 cents compared with Australian oats 13 cents and Indian oats 10 cents.

Gram is a rich food having a narrow nutrient ratio, is richer in proteids than oats or paddy and has less indigestible matter. The food-units per 100 lb. are 117 compared with Australian oats 104 and Paddy 89, and should be given in the diminished proportion of 117 : 104 if gram is substituted for a portion or the whole of the oats, and in the proportion 117 : 89 if substituted for the whole or a portion of the paddy. 10 lb. of gram per diem is the maximum for this food, as it is heating. The price per feeding unit is the same as price per feeding unit of paddy.

Australian horse food is richer than Indian horse food ; bulk for bulk it is heavier ; per food unit it is dearer.

RATION.

To make up a ration from the tables, taking as a basis that a daily ration is 20-30 lb., according to the work to be done, of which half is oats the remainder hay, or in this country chaff, bran and grass, 10 lb. oats=11·8 lb. paddy; dividing this up into paddy and gram in the ratio of their nutrient ratios it will be found equal to 5-5·5 measures of paddy and 2-2$\frac{1}{3}$ measures of gram, 7$\frac{1}{2}$ measures uncrushed hard food per day for the horse in moderate work; this can be lessened or increased as the work is less or greater. A daily ration of 4$\frac{1}{2}$ measures crushed paddy, 10 measures Indian Bran, 1 measure crushed gram, gives 5·4 lb. paddy, 4·5 lb. Bran, 1·49 lb. Gram—total 11·69 lb., (or per month, a bag and a half paddy (108 + 54 lb.), a bag and a half Indian Bran, half bag gram), yielding 10·99 Food-Units, against 10·44 Food-Units yielded by 10 lb. oats, with a nutrient ratio similar to Australian Oats, and costing Rs. 25·50 in Colombo, which with straw, shoes, muthu, grass, salt and repairs comes to a total stable account of Rs. 50-52 per month.

A. BRUCE.

DURA BREAD.

In Egypt, the Sudan, and other parts of Africa, where dura *(Sorghum vulgare)* is largely grown, it is the staple food of the people. It is also used for feeding cattle and poultry, and for a variety of other purposes. Its possible uses in Europe have been dealt with already in this Bulletin (1911, 9, 253; 1913, 11, 33); in the present note it is proposed to deal with its use for bread making. In a pamphlet published recently by the Ministry of Agriculture, Egypt (EGYPTIAN AGRICULTURAL PRODUCTS, No. 1A, p. 22), and dealt with more fully subsequently in this Bulletin (p. 482), an account is given of the preparation of dura bread in Upper Egypt, where this crop is the chief source of flour. For bread making it is almost always used in combination with either wheat, barley, fenugreek, or even beans.

In an article in L'AGRICOLTURA COLONIALE (1915, 9, 217) a summary is given of experiments in bread making with dura that have at various times been carried out in Italy. Results of experiments in which dura was used alone and in admixture with wheat in various proportions are tabulated, and analyses are given of bread made with dura, and with various mixtures of dura and wheat; in comparison with those of bread made from wheat and other cereals. Analyses are also given of dura flour prepared from the grain produced in various countries, together with corresponding figures for the flours of wheat, rye, maize, and barley. These figures show the high nutritive value of dura, and are of special interest at the present time in view of the high prices of wheat and cereals generally.

Bread made from dura flour with an admixture of 25 per cent. of wheat flour had all the desirable qualities of good bread; its taste was excellent, and superior to that of bread made from wheat flour in admixture with rye, rice, or potato flours. Bread made from dura flour alone was of excellent quality and taste, and had several points of superiority over bread made from rye or maize. Such bread made by European methods is of course quite different from the dura bread made by the methods in vogue in Egypt and in other parts of Africa.

The cultivation of dura in Italy in place of maize has been suggested, and has been tried already on an experimental scale. The chief objection to this crop is its late ripening, but it is anticipated that this disadvantage may be minimised by limiting its cultivation to the southern parts of the country or by planting comparatively early-ripening varieties; it is also hoped that improvements may be effected in this and other respects by means of selection.—IMP. INST. BULLETIN.

WEED KILLERS.

E. CRIVELLI.

In treating of the so-called plant poisons, the writer deals with the various methods for the destruction of weeds.

Many American farmers use a 5 per cent. solution of copper sulphate or a 15 per cent. solution of ferrous sulphate to destroy weeds growing with cereals; a single spraying destroys most of the weeds in a few days, without any damage to the crop.

In tropical countries, where the luxuriant growth renders the upkeep of railways particularly costly, resort is had to arsenical mixtures to keep the tracks free from weeds. A liquid of this type used by a South American Railway Company consists of white arsenic 72 gms., caustic soda 15·5 gms.,

phenolphthalein sufficient to give an intense colouration, water to make up to 100 cc. This solution diluted 1 in 10 is sprayed over the whole width of the track by means of special trucks attached to the end of goods trains, at the rate of about 1 quart per square yard. During the first it is repeated every three months, then every six months. The Columbia and Eucador Railways have adopted a liquid composed of equal volumes of a 17 per cent. solution of nitrate of soda and a 20 per cent. solution of arsenious acid.

In Europe this treatment is only required on roads paved with cobbles and on walks in gardens and parks. The writer has experimented in such places with sodium sulphide; though dearer, this is more practicable near habitations. Sodium sulphide has also been suggested for the sterilization of soil before sowing. This method was then adopted in the United States, using cheaper barium or calcium sulphide in place of the sodium sulphide. Considerable quantities of the sulphides of the alkaline earths are in common use in the United States for destroying noxious weeds in the soil.

In a recent patent by L. CHEESEMAN (U. S. A., No. 1076818, October 20, 1913), the sterilization of the soil is effected by means of a mixture of barium sulphide and quicklime. A patent by BELLANGER (France, No. 433159, August 10, October 26, December 17, 1911) comprises a mixture of barium sulphide (25 parts), barium aluminate (50 parts) barium chloride (25 parts). Another patent (U. S. A., No. 1070808, August 19, 1913) proposes the treatment of furrow slices with a mixture of anthracene oil and humus.

A fertilizing and fungicidal powder patented by FONTAINE (France, No. 433127, November 1, 1910, November 4, 1911, January 15, 1912) has the following composition :—Flowers of sulphur 6 parts, potassium chloride 5, superphosphate 5, quicklime 55, sulphate of iron 20, water sufficient to slake the lime. Another mixture with the same object was patented by DOKKENWADEN (France, No. 389729, April 29, July 7, September 10, 1908) and consisted of 452 pounds of saturated solution of sodium nitrate, 22 pounds of potassium chloride with 72 tons of absorbent matter (wood pulp, etc.) or else 880 pounds of superphosphate with 116 tons of marl, the whole mixed with raw petroleum or phenol at the rate of 44 pounds per ton. There is also a powder devised by MATHERON (France, No. 336117, October 29, 1903, February 29, 1904) for the destruction of weeds consisting of a mixture of copper sulphate and ferric chloride, with a salt of salicylic acid : it is used in solution of 20 to 30 pounds per 100 gallons, at the rate of about 90 gallons per acre.—BULLETIN OF FOREIGN AGRIC. INTELLIGENCE.

SCIENCE AND EDUCATION.

SIR RONALD ROSS refers in SCIENCE PROGRESS to the papers read by PROF. JOHN PERRY and PROF. ARMSTRONG at the British Association Meeting and after quoting from the latter to the effect that "Science must be organised as other professions are organised if it is to be an effective agent in our civilisation," goes on to say :—"There are really two points at issue in these papers, first the general British disinclination for scientific work and thought, and secondly, the rejection of science in education. Everyone deplores the former defect, but we do not see clearly how it really depends upon the latter. There has grown up an entirely unreal system of education—as unreal as "the square root of minus one," but as much loved by some people as is that mysterious entity or non-entity by others. Just as mathematicians make books out of their imaginary quantities, so do schoolmasters try to make men out of theirs—and in both cases the results are apt to be more curious than useful. We would be the last to object to a true classical education ; but then that education must always be combined with a scientific one. Unfortunately, what

the boy really receives is not a classical education at all, but a grammatical one —quite another thing. Nothing is more educative than a knowledge of the masterpieces of literature in all languages; but our youths do not receive any such instruction. It is doubtful whether many of them have ever even read through the Iliad so as to understand the wonderful construction and the wisdom of the great fable which it develops for the purpose of adding wisdom to mankind. This is not taught, but the boy is kept writhing on the gridiron of grammatical difficulties. Even with regard to English literature the masterpieces are not read by the boys in an intelligent manner, but are merely used for philological texts. The result is that few of our young people are even acquainted with the masterpieces of literature, and are certainly ignorant of their beauty and incapable of appreciating it. Thus when they grow up their minds are content with the most trifling fiction and the most puerile drama. Similarly, even in the teaching of mathematics, our boys are kept trifling in the porch—worrying over permutations and combinations or burrowing into the depths of conic sections, when they should be taken to the top of a mountain and be given a wide survey of the whole field. Thus they too are instructed only in the ground work, and remain for all their lives ignorant of the main meaning and scope of what was intended to have been taught to them. When we add to such negative teaching all the facts of nature discovered laboriously by many great workers, the square root of the sum results in the modern Briton—at least so far as his knowledge goes.

We do not wish to see any branch of knowledge removed from the curriculum. All knowledge is valuable: but we do not wish to see the receptive years of youth wasted upon unimportant knowledge when they might be used for the acquisition of important facts. The real fallacy of the schoolmaster is his supposition that education is valuable chiefly as an exercise and not as an opportunity for laying in stores of information. If this were the case, nothing should be more carefully taught in schools than the games of chess, which is perhaps just as good an exercise in many respects as are mathematics or classics. But the time of youth is short, and the opportunities soon vanish; and the boy kept trifling in the porch is apt, when he becomes a man, to leave it abruptly with some anger in his heart and without ever having entered the beautiful temple within."

Under the head of "pine-apple memos" the Queensland Agricultural Journal gives the following information.

The returns from pine-apple cultivation on fair to good land fluctuate and vary from £35 to £80 per acre. The average yield of crop may be said to be 10,000 to 12,000 fruits or 10 to 15 tons per acre.

A man should be able to clear, manure and generally tend 10 acres or even more. It depends on the man, nature of soil and kind of labour (horse or hand). Intercrops, such as peas, beans, tomatoes, etc., may also be grown with pine-apples for the first year or two, but fertilisers must be employed to make good any deficiency thereby.

Naphthalene in a finely divided form is recommended as a soil fumigant. Used in the proportion of 1 cwt. per acre it keeps wire worm away, but for garden purposes about 1 lb. is used for every 8 or 10 square yards of soil. The Tokio Agricultural College found that for destroying nematodes the proportion of naphthalene need not exceed ·005 per cent. of the soil.

MEDICINAL PLANTS.

So long the Continent has been the chief producer of drug and medicinal plants, and this source has now been practically shut out by the war. The necessity therefore exists for the British colonies producing as much of the raw materials as possible, and in the JOURNAL OF AGRICULTURE, VICTORIA, we read of steps being taken toward this end. The Department of Agriculture, the Education Department and hospitals and schools are co-operating with a view to finding out what medicinal plants could be grown with success in Australia.

For the present, says the Journal, a number of plants are receiving attention, for which there is a considerable demand for medicinal purposes, viz.

1.	Aconite	...	*Aconitum Napellus.* Linn.
2.	Beech	...	*Fagus sylvatica.* Linn.
3.	Belladonna	...	*Atropa Belladonna.* Linn.
4.	Bitter or Seville Orange	...	*Citrus aurantium* var. *Bigaradia.* Hook F.
5.	Buchu, or Bucku	...	*Barosma betulina.* Bart and Wend
6.	Cascara Sagrada	...	*Rhamnus Purshianus.* D. C.
7.	Meadow Saffron	...	*Colchicum autumnale.* Linn.
8.	Foxglove	...	*Digitalis purpurea.* Linn.
9.	Gentian	...	*Gentiana lutea.* Linn.
10.	Golden Seal	...	*Hydrastis Canadensis.* Linn.
11.	Henbane	...	*Hyoscyamus niger.* Linn.
12.	Juniper	...	*Juniperus communis.* Linn.
13.	Licorice	...	*Glycyrrhiza glabra.* Linn.
14.	Lobelia	...	*Lobelia inflata.* Linn.
15.	Male fern	...	*Dryopteris (Aspidium) Felix-mas.* Schort.
16.	Opium poppy	...	*Papaver somniferium.* Linn.
17.	Peppermint	...	*Mentha piperita.* Smith.
18.	Broom	...	*Cytisus scoparius.* Linn.
19.	Senega	...	*Polygala senega.* Linn.
20.	Senna	...	*Cassia acutifolia.* Deble. *Cassia augustifolia.* Vahl.
21.	Stramonium	...	*Datura Stramonium.* Linn.
22.	Strophanthus	...	*Strophanthus Komle. Otiver*
23.	Dandelion	...	*Taraxacum officinale.* Wiggers.
24.	Valerian	...	*Valerian officinalis.* Linn.
25.	Viburnum	...	*Viburnum prunifolium.* Linn.
26.	American Wild Cherry	...	*Prunus serotina.* Linn.
27.	Witch Hazel	...	*Hamamelis virginica.* Linn.
28.	Anise	...	*Pimpinella anisum.* Linn.
29.	Castor Oil Plant	...	*Ricinus communis.* Linn.
30.	Camphor Tree	...	*Cinnamomum camphora.* Nees and Eber.
31.	Rhubarb	...	*Rheum officinale.* Linn.
32.	Lavender	...	*Lavendula vera.* D. C.

THE JOURNAL OF THE BOARD OF AGRICULTURE, England, prominently mentions Aconite, Belladonna, Dandelion, Foxglove, Golden Seal, Henbane, Poppy Datura and Valerian, as likely to be in demand.

SCIENCE FOR ALL.

The little attention given to science in education and in the public mind has been the theme of many essays and addresses. In both cases science is usually regarded as suitable for study by a select few only, and not as an essential part of all modern life and thought. Latin and Greek, history, and the literature of other times receive almost as much consideration now as they did before scientific discovery changed the whole aspect and outlook of life; and the mass of the people, as well as most of their leaders, are in their training deprived of light which should illumine the minds of all.

We do not for a moment suggest that the end of all education should be preparation for scientific careers; neither do we ask that men of letters, statesmen and administrative officers of departments of State should all be scientific experts. To make such claims would be unreasonable, though not more so than the accepted principle that familiarity with classical languages and literatures is a necessary qualification for such positions, and that the first place must be given to these subjects even if matters more closely related to modern conditions of existence in war or in peace have to be neglected. Our claim is that everyone—from elementary school pupil to college don—should be acquainted with appropriate outlines of scientific work and thought. We want science to be a part of every general education, and we urge that the times demand this recognition of its influence and potentialities. When this modernisation has been accomplished, facilities for scientific work will be increased a hundredfold, and the public will not be deceived by sensational announcements in the daily Press, or tolerate official indifference to the growth of natural knowledge.

It may be doubted whether the methods now followed in the teaching of scientific subjects in schools are as effective in creating or fostering interest in science as those formerly adopted. Twenty years ago or so, much more attention was given to the attractive side of science than is now the case. Pupils were shown interesting experiments or were encouraged to read about remarkable facts and phenomena in nature; and if they took a practical course they were able to cover a fairly wide field.

Personal observation, intelligent inquiry, quantitative tests are, of course, essential factors of scientific method, but we believe that to insist upon all school science being controlled by them is a mistake. The limited amount of time that is given to science in schools renders true research methods impracticable; and pupils in general can scarcely be expected themselves to possess the motive and the purpose that lead to scientific investigation. Every teacher knows that only rarely is a pupil capable of initiating an experiment or of arriving at a statement of law or principle from results obtained by practical work. Little justification can be found, therefore, for the concentrated attention given to a few subjects, with the view of imparting knowledge of experimental methods, when such a course means that the wonders of the fields beyond are kept outside the range of vision.

School science as at present taught, and as defined by examination syllabuses, seems to proceed on the assumption that every pupil is to become a skilful experimenter, or an original investigator, in the realms of Nature. Courses of laboratory work designed with this intention may not unfairly be compared with the test-tubing of former times, which aimed at making every boy an analytical chemist. The practical work now done is certainly more valuable as a means of scientific training than it used to be, but it may be doubted whether by such exercises science can claim a prominent place in the curriculum. Modern life requires that the elements of scientific method

and knowledge should form part of every educational course. School work should not be concerned in training experts in science, any more than specialists in classics, but with imparting the rudiments of a liberal education to all pupils, so as to awaken interest which will continue when schooldays are over.

That is the standard—abiding interest—by which successful teaching may be judged; and we are disposed to think that the descriptive and qualitative school science of a generation or two ago was better adapted to promote such continued attention than is the quantitative work in the narrow fields mapped out for instruction to-day. In their anxiety to impress pupils with a sense of scientific accuracy and cautious conclusion, advocates of the methods now in vogue have forgotten that it is even more important to present a view of science which shall be human as well as precise. To the general neglect of this aspect of scientific study, which appeals to all, must be ascribed the fact that science has lost much of its former popularity, and has become a task in which only a favoured few can hope to excel.

The achievements of science represent increase of knowledge, not alone for the man who makes it, not alone also for the nation or country to which he belongs, but for the whole human race. The conquests of science do not mean the aggrandisement of the country or people at the expense of another, but gifts to all who will receive them. The only domain which it is desired to penetrate is that of ignorance; and the fight is against the physical and mental death which is its heritage. Ignorance made plague the terror of Europe in the Middle Ages; science has proved that the disease is due to a bacillus which is conveyed by fleas from rat to rat, and from rats suffering from the disease to mankind. Ignorance ascribed malaria to a miasma or bad air arising from marshy places; science has shown it to be carried from one human being to another by a certain species of mosquito. Ignorance of the cause of yellow fever made the regions round the Caribbean Sea the White Man's Grave, where the risk of death for the visitor was greater than in battle; knowledge that the disease is communicated from an infected to a healthy person by the bite of a particular mosquito has been the means of converting the same places into tropical health resorts. One practical result of the discovery of the cause of yellow fever was that it made possible the construction of the Panama Canal. It was not a hostile army or political difficulties that obstructed the work commenced by DE LESSEPS, not mountain chain or desert waste, but an insect which raised a barrier of disease and death between endeavour and accomplishment.

We have in uplifting stories of this kind—and there are many others—plenty of themes for epics which rightly used, will stimulate interest in science, in both old and young. When a place for such literature is found in every educational course, the number of people who will follow scientific work with sympathetic minds will be greatly increased. At present school science means mostly determinations of specific heats or chemical equivalents, and similar exercises, while the deeds and thoughts which live giving interest to material studies are neglected altogether. We do not ask that science students only should be given much broader views of natural knowledge than can be acquired through laboratory manuals and class text-books, but that the historical and literary studies in all schools and colleges should include works in which great scientific achievements and generalisations are expounded. We are confident that such subjects can be made attractive to almost every mind, and that the want of general and intelligent interest in them is due largely to the neglect of descriptive scientific literature in all stages of instruction.

It is unfortunately true that men of science themselves are often interested in their own special field of work, and pay little attention to what

is being done in other directions. These are the days of specialised study, and though the high powers used for the eyepieces enable new details to be discerned, the field of view is greatly restricted in extent, and the sense of true proportion is lost. Specialisation is essential for advance, but when it also means indifference to external movements and influences, it does not represent the highest type of intellectual activity. We cannot urge with any force the desirability of bringing the laity to appreciate the outstanding points of scientific work if specialists in particular sections of such work manifest no interest in the results of investigations by their colleagues in other departments, or will not trouble to make themselves understood outside their own esoteric circle. Papers read before scientific societies are now so highly specialised that only occasionally can they be followed with intelligent interest by the whole of the fellows present at a meeting, and usually not more than two or three people are capable of criticising them. As this is the case in circles where at any rate the general language of science is understood, it is not strange that people who have not had a scientific education should believe that scientific description must be beyond their comprehension.

This belief is probably responsible for the fact that there is little demand for popular works on science and few large audiences for scientific lecturers. We can say without fear of substantial contradiction that in such an inspiring subject, for example, as astronomy, attempts at popularisation by books or lectures have less chance of success than they had fifty or a hundred years ago. We are well aware that there are a few individual exceptions to this generalisation, but the statement can be fully justified as a whole, not only as regards astronomy, but also by the experiences of most authors and lecturers in other branches of science. There has been a vast increase in periodical publications and general literature has been in the direction of text-books and treatises rather than in popular works, to which little encouragement is given, either by men of science or the public.

We should be sorry to suggest that scientific work is necessarily associated with poor literary style; indeed, we are sure that the literary compositions of men of science compare very favourably with those of other workers who are not purely men of letters. It may be doubted, however, whether sufficient encouragement is given to young scientific men to cultivate the power of clear expression, or whether sufficient appreciation is shown of efforts at making science intelligible to the people. An author like MR. H. G. WELLS, who creates wide interest in scientific work, is doing far better service to science than he would if he had concentrated his attention upon the minute biological structures of his early days as student and teacher. It would be greatly to the advantage of science if there were many more writers possessing like scientific knowledge with brilliant imagination and convincing pen.

Science can only secure its rightful position in a democratic State when its work and worth are widely known and understood. The makers of new knowledge can be trusted to continue to add to the stores already accumulated, but they should remember also that popular interest means increased support for their work and greater use of the results. It is rarely that great capacity for original investigation is combined with the gift of attractive exposition, and more rare to find both qualities being used for the popularisation of science, as, for example, in SIR RAY LANKESTER'S series of masterly notes and essays, three volumes of which have now been published. We believe the influence of such literary work upon the public mind is much greater than is generally understood, and we should like to see many equally attractive efforts of a similar kind in other scientific fields than those with which SIR RAY LANKESTER is most intimately acquainted.

The war has made people think of more serious things than those which had their attention a year or two ago, and there are signs that a more satisfying literature will be required than the light pabulum which has hitherto served What could be better adapted to provide for the coming need than the rich materials of science when attractively displayed? It is the privilege of scientific workers to have garnered these stores; and it is equally their duty to see that the nation does not perish for want of the stimulating food which they can furnish. If science does not come into its kingdom in the immediate future, it should not be for want of endeavour to enlighten the mind of the public and create intellectual interest in its aims, but because the people are content to be ignorant of the truths learned in the innermost courts of the temple of Nature, and to be without the power which such knowledge can give them.—NATURE.

THE IMPORTANCE OF LIGHT TO PLANTS.

The importance of light to the well-being of plants is thoroughly understood by gardeners. Daily experience shows them not only that plants must be exposed to light, but also that if the light which falls on the plant be below a certain intensity growth is checked. The reason for these facts is also well understood by practical growers, who have learned that plants require light in order to carry on the manufacture of their food. Only when light falls on them are the green parts of the plant able to construct from the raw materials—water and carbon-dioxide, which they obtain from the soil and air—the sugar which serves as an actual food material for the plant. Whether light is also necessary for the manufacture of the more complex nitrogen-containing foodstuffs, which the plant has also to make for itself, is not so certain.

What is certain, however, is that the effects of light on plants are by no means confined to this essential part in food-manufacture. As is well known, light is one of the great directive agents of plants. By its aid plants, like animals, find their way. That is to say, each leaf and stem and branch contrives to take up its proper position as a result of movements of adjustment in reference to the direction of the light which falls on that member. By means of this response to light ordinary leaves come to stand at right angles to the direction in which light falls on them.

In yet more subtle ways light affects the fortunes of plants. For example, it is well known that if the light which a plant receives be of insufficient intensity, although vegetative growth may continue the plant may fail to flower. Although the fact is known the explanation is not. It was suggested long ago that light of a certain wave-length (ultra-violet light) plays an important part in stimulating the development of flowers. Recent discoveries of PROFESSOR LOEB suggest that this old view may contain something of the truth for LOEB has shown that the eggs of certain animals (sea-urchins) begin to divide when exposed to ultra-violet light.

Another recent discovery which may perhaps lead to results of practical importance has reference to yet another effect of light on plant-growth. This discovery concerns respiration, the process whereby the plant (or animal) by bringing about the oxidation of its own substance—and particularly of the sugars which it has manufactured—obtains the energy whereby it does the work of living.

This process of respiration goes on unceasingly night and day in both plants and animals; but it has been known for some time that the rate of respiration, which is measured by the amount of carbon dioxide given off is definitely greater during the hours of sunlight than during darkness. The

most recent investigations have yielded what at first sight are remarkable and puzzling results. Thus it has been found that even though a plant be kept in absolute darkness (and in a constant temperature) the amount of carbon dioxide given off by the plant is greater during the day than during the night. The explanation of this curious fact is to be sought in the effect of sunlight on the oxygen of the air. The effect is termed ionisation, and it may be likened to that produced by a stonebreaker on a heap of stones. In unionised air the oxygen is composed of unbroken stones (molecules); when ionised, the oxygen consists of minuter particles which may be likened to the broken stones. These minuter particles of oxygen combine more steadily with the oxidisable plant substances than do the unbroken molecules, and hence the rate of respiration is increased. It would appear not impossible that practical advantage may be taken of this fact, and that by supplying them at night with ionised air the rate of growth of plants may be increased. The experiment, so far as we know, has not yet been tried, but if the facts described above are correct it is not impossible that "forcing by ionised air" may become a useful adjunct to the horticulture of the future.—GARDENERS' CHRONICLE.

SOME CROPS OF MANNAR.

COTTON.

This product is not heard of in this district nowadays. There are records of a cotton plantation undertaken by Government in 1802. MR. BOAKE (1888) records the introduction of New Orleans seed ; a sample of the cotton grown was sent to Peradeniya but nothing seems to have resulted from it. Recently (1903) MR. DENHAM in his Administration Report records an experiment with cotton on some black soil in Vanni pattu, Nanaddan and Mantai, but the following Administration Reports do not give results.

The climate is admirable for cotton, but attempts should be directed to secure a variety that is a heavy yielder rather than the production of a very high staple. The cotton should be planted about the end of September or early in October and harvested in March or April. Maize and the sorghums will form a very good rotation, whilst very good pulses can be easily selected to suit the district. Under irrigation sugar cane should prove to be a very paying crop. I have seen some very fine juicy canes grown in the District.

TOBACCO.

This product is still grown in the District but the area is decreasing due, according to MR. DENHAM (Administration Report, 1903), to three factors: (1) "The supply was greater than the demand. (2) The Batticaloa cultivator can turn out the 'covering leaf,' for which Mannar tobacco was used, cheaper than the Mannar cultivator. (3) A decline in the demand for Jaffna cigars, due to the increase in cigarette smoking." MR. BOAKE writes thus about tobacco. "The cultivation of this 'naughty Indian weed' seems to have been carried on from a very early period, and to have gained a reputation for strength of quality. It is still grown in considerable quantity, and I have smoked cigars made of it, which in strength and flavour surpass even the best Dumbaras, and are infinitely preferable to most of the Indian and Burmese cigars I have tried. The only thing against them is that the leaf is insufficiently fermented, and the make is atrocious" (Mannar—A monograph. 1888).

The area under tobacco varies yearly from 100 to 250 acres. It is cultivated chiefly in Illuppaikodavai, Attimoddai, and Vidattaltivu, but now coconut plantations are being made on good tobacco land. The cultivating season is from December to April and cultivators from Jaffna migrate to these centres at this time.

COCONUTS.

The acreage under this product is increasing. It is believed that early in the nineteenth century there was a large area under coconuts. At present there are about 3,500 acres under coconuts. The nature of the soil limits the extension of coconut plantations to the coastal strip; further inland the soil or subsoil is a stiff clay and is unfavourable for the growth of the palm.

PALMYRAH.

The area under this product is decreasing. An interesting method of cultivation for the young palmyrah roots is practised annually; the plants are dug up when about a few months old and the hard starchy roots (*Kilangu*) are sold. This forms part of the food of the poorer classes who make cakes with the pounded flour, jaggery and toddy.

HENRY L. VAN BUUREN (JR.).

THE COMMON CROW.

Many of our present criticisms of this bird, as its pulling corn, feeding on ripening ears, damaging fruits of various kinds, destroying poultry and wild birds, and disseminating diseases of live stock, were common complaints in the days of the early colonists. Many of the virtues of the crow, now quite generally recognized, also have been matters of record for many years. In recent times, however, scientific study of these problems, including the examination of the stomachs of hundreds of crows secured in every month of the year and under a variety of conditions, has enabled us to render a much fairer verdict than was formerly possible.

The crow is practically omnivorous. During spring and early summer any form of insect life seems to make a desirable item in its diet, and in winter when hard pressed nothing in the animal or vegetable kingdoms which contains a morsel of nutriment is overlooked.

The insect food of the crow, which comprises about a fifth of its yearly sustenance, does much to atone for its misdemeanours. Grasshoppers, May beetles and their larvæ (white grubs) caterpillars, weevils, and wireworms stand out prominently. In 1,103 stomachs examined these highly injurious forms comprised over 80 per cent. of the insect food. Grasshoppers are naturally taken in great abundance late in the season, September being the month of largest consumption, when they form about a fifth of the total food. May beetles and white grubs are eaten in every month except January, but occur mostly in May. In June caterpillars are a favourite food, and weevils of various kinds are taken in varying quantities throughout the summer and fall. About half the remaining 20 per cent. of insect foods is composed of beneficial ground beetles, ladybirds, predacious bugs, and parasitic wasps, and related forms, the rest consisting of neutral or injurious forms. Numerous instances are on record where fields badly infested with white grubs or grasshoppers have been favourite resorts of crows, whose voracity has resulted in a material suppression of the pest. When the amount of food required to sustain the individual crow is considered, the work of these birds appears all the more important. Single stomachs containing upwards of fifty grasshoppers are not uncommon. Thus in its choice of insect food the crow is rendering an important service to the farmer.

In the other animal food of the crow are several items of the utmost economic importance. Spiders are taken in considerable numbers in May and June, but the yearly total is a little over one per cent. of the food. In early spring crawfish are eagerly sought, and other aquatic food as fish and molluscs lend variety to the crow's bill of fare the year round. In the consumption of

toads, salamanders, frogs, and some snakes, which together comprise a little over two per cent. of the yearly food, the crow is doubtless doing harm. Small rodents occurred in the stomachs collected nearly every month, but it is often difficult to determine whether small mammals found in birds' stomachs were taken alive or found dead.

From its carrion-eating habits the crow has been unfairly criticised as a disseminator of live-stock diseases. While this may be to some extent just, the fact that there are many other important carriers which lie largely beyond our control, shows that we must seek final relief only through the strictest methods of sanitation.

The nest-robbing habit of the crow, long a serious criticism, is verified by stomach analysis. Fifty of the 1,103 crows examined had fed on wild birds or their eggs, and the eggs of domestic fowls were found slightly more frequently. The crow's habit of rummaging about garbage piles may explain much of this latter material.

Of the vegetable food, corn, which is eaten every month, is the most important item and forms about a third of the yearly diet. Much of this, however, must be considered waste. Over 60 per cent. is consumed from the 1st of November to the end of March. During the periods when corn is sprouting and when in roasting-ear stage the crow is eating this grain at a rate considerably less than the yearly average, and the months of smallest consumption are July and August. At times, however, the damage to corn becomes a serious problem, and were it not possible to make use of such deterrents as coal-tar upon seed corn there would be little friendship for the crow in some sections of the east. The "pulling" of corn is a trait most prevalent in small field areas. Wheat and oats suffer similar damage at times, especially in the north-western states, where these grains predominate. About the only safeguard to ripening grain is the constant use of powder and shot or the scarecrow.

Various kinds of cultivated fruits also are eaten, and local damage to such crops as apples, melons, peas, beans, peanuts, and almonds is occasionally reported. In long, rigorous winters, the crow, like other birds, resorts to the fruit of numerous wild plants, as dogwood, sour gum, hackberry, smilax, and the several species of sumac and poison ivy.

Damage to the eggs of poultry may be reduced to a minimum by careful housing of laying hens, and the farmer can protect his sprouting grain to a large extent by the use of tar-coated seed. It will be well also to keep the crow within reasonable numbers on game preserves and public parks where it is desired to encourage the nesting of smaller birds. While legal protection is not needed for so wary an individual as the crow, it seems well, where local conditions have not aggravated particular shortcomings of the bird, to allow it to continue the good services rendered to man in the destruction of noxious insects.—BULLETIN OF FOREIGN AGRIC. INTELLIGENCE.

THE MANUFACTURE OF SOAP.

S. G. SASTRY.

Soap manufacture is a chemical industry. The fats and oils, which receive in the industry the generic title of Soapstock, may be either of animal or vegetable origin. Chemically they are all glycerides of the higher fatty acids, chiefly of stearic, palmitic, oleic, and lauric acids, with some others of less importance. All fats and oils yield soaps when treated under suitable conditions with caustic alkali. It is the purpose of this paper to make a brief study of the manufacture of soaps.

In an industry the situation of a factory is of very great importance. Nearness to the raw products, a constant and steady supply of labour,

facilities with regard to fuel and water, communications by railways and by sea in connection with the import of raw materials and the export of the finished product—these are some of the main points to be considered. Bangalore seems to be a place eminently suited for this purpose, being a very important railway centre, and also having an abundant supply of water, and of fuel also in the casuarina plantations in the District. The conditions of labour also are very satisfactory.

In all well managed concerns it is the quality of labour that is of primary importance. Expert labour is always necessarily costly but in the long run it is much more paying than cheap and unprofessional labour. Since in all chemical industries there are a lot of unseen and preventible losses, high class and professional labour will reduce such losses to a minimum. Efficiency is the main point to be aimed at and cost of labour is of secondary, but still very important, consideration. The skill of the manufacturer consists in getting expert men at as low a price as possible. Much care and thought have to be bestowed to ensure a careful selection of employees in the factory. In England in most of the celebrated soap factories, before entering a firm's employment both boys and girls must have passed the sixth standard and have attained the age of 14. MESSRS. J. CROSSFIELD & SONS, LTD., Warrington, who are one of the largest manufacturers of soap in the world, make it compulsory upon all boys and girls in their employment between the ages of 14 and 17, to attend an evening school at least three nights a week. The course of instruction for boys is naturally concerned with questions relating to their special line of work. Girls are taught domestic economy, etc.

Even though it seems difficult to attain the same state of affairs at Bangalore, for the majority of the employees at least, it seems to be the best policy to fix the lower Secondary Examination as the test to be passed before they can be admitted into such a factory for any responsible work.

COST OF PRODUCTION.

It is essential to success in the soap industry to-day not only to obtain the raw materials cheaply, but also to use them economically and efficiently in the way discovered to be the best research experiment. The commercial prosperity of many a firm to-day depends on the policy of its technical staff of experts. Experiments should be constantly made and patient research conducted and the results obtained applied for the economic production of the desired articles. While conducting experiments in the laboratory the sense of proportion is lost, and though valuable indications may be obtained by working with one or two pounds of the materials, still they will have to be modified considerably to suit the factory conditions, and in all flourishing soap factories it is usual to have small experimental plants, where the results of the laboratory research are first tested before being adopted for use in the factory on a large scale. The hardening of oils and fats *(hydrogenation)* is one of the best examples of what chemical research can do in a soap factory.

It is a trite point to mention that the raw materials should cost as little as possible. But often it is found to be more advantageous to have a dearer raw material. A cheaper quality fat, if bought, may have to be bleached and deodorised, and on account of these things the cost of production may go up very much. Before passing on to the next subject it is worth while to note that the appearance of the finished product will have a great deal of influence on its selling properties, as in all other kinds of business. For example, a certain section of the Indian customers desire to have transparent soaps. Another variety of soap having superior merits with regard to lathering power and detergency, if it does not possess the same standard of transparency, will not appeal to the eyes of that section of the customers, and consequently will not "sell" to the same degree as an inferior article,

simply because the latter has the bright, trim and transparent look that the public demands. In a similar manner, a perfect soap, if only in a shapeless lump, will not "catch" the market as much as a nicely trimmed and attractively shaped tablet, wrapped in a piece of tissue paper, and then neatly packed in boxes. All these things increase the cost of production, but the public demands it, and a successful manufacturer caters to the public taste.

There is another interesting fact to be carefully considered in connection with the cost of production. Now-a-days all important soap concerns in any country will have their own "causticising" plants—I mean that they buy the sodium carbonate and lime, and then prepare the sodium hydroxide or caustic soda from them in their own establishments. This method is on the whole a very economical one, and even though, in its early stages, a soap factory started in Bangalore may buy caustic soda from the Western countries, eventually at least the soap factory will have to have its own alkali plant.

There is ample scope for alkali industry in India. In the Mysore State, with a plentiful supply of electricity, there seems to be no reason why an enterprising man should not start to make caustic soda and bleaching powder, by the electrolysis of common salt. But this is a digression from our subject.

It is often remarked that the degree of civilization of any country can be found out by the amount of soap consumed in that country, On this principle, India is only gradually getting civilised in the eyes of many people, although these when they apply the doubtful principle to India, quite naturally forget that there are many excellent substitutes for soaps, which are being used extensively all over the country. But still it may be confidently said that the demand for soaps is increasing day by day and this steady demand should prove the prosperity of any soap manufacturing concern started on a sound basis. Toilet soaps are in great demand and at present it is for cheap toilet soaps; household soaps hold the market next; textile soaps have only a very limited sale. A toilet soap with quick lathering power and also a good detergent, which can be sold anywhere between three to four annas per tablet of the recognised popular size, is bound to hold the market and sell very well. Such a soap would presumably contain rosin.

MACHINERY.

In all well managed concerns only well designed plants will be used; because crude plants, even though they may not cost much at the beginning are much more costly in the long run than are well designed plants. As for the size of the plant, in all manufacturing concerns there is always an economic size of the plant to give the maximum product at a minimum cost. This is to be determined upon by taking all the aspects of the business into consideration. This is rather a ticklish job to settle, because many things that are extremely well paying on large scale productions will not be paying at all on a small scale production.

In many cases low cost on capital consideration is essential; and if additions are to be made, they are not to be introduced until 20 per cent. per annum on the improvement is ensured in the return. Also the cost of the improvement should be recovered within two years of introducing the improvement. It is very important that an Indian manufacturer should bear in mind while purchasing a plant the following points:—(1) The plant must be easy of control, (2) the ease and rapidity in making repairs, (3) the possibility of making temporary repairs while the plant is working, (4) the time lost in getting the plant into full swing of working order and also the time lost in shutting down the plant after the work is finished.

For a very small soap works, with a modest output of five tons of soap per week, the following things are necessary:—One soap copper, one tallow and oil melting tank, one caustic melting tank, one caustic, tallow and soap pump, lye tank, ten soap frames, two hand crutches, one slabbing frame, one

barring machine, one hand stamping machine, drying room fittings, and pipes and connections between the above parts,

With a greater output all the above things are to be in larger sizes and some of them in greater numbers. Steam-driven crutches may be used. If the spent soap lye is to be treated a glycerine-refining plant is to be added to the above list.

It is only in very large works that soap cooling machines, power driven stamping machines, etc., can be used. In smaller works humbler devises should prove their use.

KINDS OF SOAP.

According as the soap is hard or soft, it consists of the sodium or potassium salts of a mixture of higher fatty acids. These are in the case of a hard soap stearic, palmitic, myristic, lauric, oleic acids, and to a less degree caproic, caprylic, capric, arachidic, and erucic acids, In the case of a soft soap, these are chiefly oleic, linolic and linolenic acids. Since the sodium salt of rosin possesses valuable detergent properties, many well-known brands of household soaps contain rosin also. Even though the household soap and also the cheaper brands of toilet soaps may contain rosin, it is to be considered as an adulterant in high class toilet soaps. Many cheap varieties of washing soaps contain what is technically known as "running" or "filling." For this purpose sodium carbonate and sodium silicate are used in varying proportions, and enable the soap to carry more water. To go into more details on the composition of soap would not interest the general reader. So we pass on to consider the next subject.

RAW MATERIALS.

The raw materials consist of oils and fats and caustic alkali. If soap stock fatty acids are used then sodium carbonate may be used instead of caustic soda. The soaps prepared from different oils vary in their properties to a very great extent and hence in practice to obtain a soap of any desired quality various oils and fats are blended. At the present day the chief oils and fats that are used in soap making are tallow, lard, palm-oil, coconut oil, palm kernel oil, arachis oil, soya bean oil, castor oil, cotton seed oil, olive oil, linseed oil and, although neither a fat or an oil, rosin.

Many of these oils can be obtained in Mysore in sufficient quantities, and the above list may be supplemented with honge oil and dhup-seed oil. From the examination of the physical and chemical properties these two oils promise to be excellent soap stock. Honge oil possesses a characteristic smell which is not permissible in soaps. An economic method of deodorising is to be found out and the oil treated properly before use. Another drawback for the use of this oil is the high percentage of unsaponifiable matter. An improved method of obtaining the oil may remove this drawback to a certain extent at least. Dhup-seed oil can act as an excellent substitute for tallow and palm oil. Its titre is 54·8°C. It seems to have a high acid value which can be guarded against by bestowing some care in its method of preparing. There is another interesting fact recorded about this dhup-seed, namely that it contains to the extent of 2 per cent. a pleasantly smelling volatile oil which can be extracted with alcohol. It may be worth while to investigate the problem further and find out the commercial possibilities for this volatile oil.

The only other chief raw materials required are caustic soda, sodium carbonate, sodium silicate, common salt and rosin, with some others of less importance. Perfumes—both natural and synthetic—are required for toilet soaps.

It was mentioned earlier in this paper that the oils and fats are to be blended in order to give a soap of any desired quality. It would be clearer if an example were taken. Suppose we had to manufacture a household soap which can be used for washing clothes—suppose also that we had at our disposal cotton seed oil, coconut oil, tallow and rosin. Cotton seed oil by itself would give a soft, slimy and greasy soap, white when fresh and apt

to become rancid and yellow on drying. The soap is very difficult to salt out even with much sodium cholride added to the pan and the soap retains a high percentage of water. The soap would not lather well. Coconut oil on the other hand if used alone would give a white, hard, brittle, noncurdy soap if salted out well. The soap dissolves in water and even in weak brine; lathers easily and freely, but the lather is not persisting. The soap can hold large quantities of water and "filling" and still remain hard. Rosin (neither an oil nor fat) gives a thin soft sticky soap; can be "*killed*" either by caustic soda or sodium carbonate. The soap is devoid of body but is an excellent detergent. Finally tallow would give a white hard soap, dissolving but slowly in water. It lasts well in use, and lathers well but with difficulty.

If instead of using any of them separately, all the four were blended in certain proportions and then saponified (rosin is conveniently saponified separately and the resulting product added to the soap pan in the final stage) we ought to get a fine soap possessing all the properties desired. In fact the recipe for one of the well known brands of the household soaps imported to India from England, seems to be 25 per cent. of each of the materials named above. Substituting dhup-seed oil for tallow, and possibly honge oil for cotton seed oil, any manufacturer in Mysore should be able to produce an excellent household soap second to none now on the market, and should be able to compete with others.

PROCESS OF MANUFACTURE.

We now come to the actual process of manufacture. The whole process for the purpose of clear understanding may be represented diagramatically as on the accompanying page.*

A mixture of purified oils and fats is boiled with a solution of caustic soda in steam heated pans holding anything from five to one hundred tons of soap. Formerly these pans used to be manufactured in cylindrical shape, with a tapering bottom. But the most modern plants have a rectangular shape with rounded corners and with a tapering bottom. For equal capacities the rectangular shape will effect a saving of 25 per cent. of floor space, which is a very important consideration in many factories.

During the process of saponification the oil or fat is attacked by caustic soda, resulting in the formation of soap and glycerine. After the saponification is complete a solution of common salt (sometimes the dry salt itself) is added to the pan. This results in the formation of two distinct layers in the pan, one of them being the soap, which is insoluble in brine, and the second layer consists of what is technically known as "the glycerine lye." This latter contains common salt, glycerine and other impurities associated with the raw materials used. This glycerine lye is drawn off from the bottom of the pan by means of taps and sent to the glycerine refinery for further treatment. The soap that is now left in the pan is mixed with rosin soap, and then boiled once more with a "strengthening" charge. After this the half-spent lye is drawn off and the soap "fitted." The process of "fitting" consists in boiling the soap with open steam until the desired degree of closing of the grains of soap is attained. In some cases the fitted soap is allowed to settle for four to six days. On subsidence the contents of the pan will have divided into the following:—(1) on top, a thin crust of soap, with perhaps a little light coloured fob; (2) the good soap containing 62-63 per cent. of fatty acids; (3) a layer of darker weak soap termed "nigre" which on an average contains about 33 per cent. fatty acids; (4) a solution containing alkaline salts. It is the second layer that forms the good soap. The first layer is taken out and put back into another pan before saponifying a fresh charge of fats. The nigres are utilized in various ways.

After completion of the saponification, and allowing the contents of the pan to settle into layers, as described in the previous section, the good soap forming the second layer is transferred into frames. The thin crust or layer

* Not reproduced.

at the top is gently removed, and the good soap is ladled out and conveyed to frames or withdrawn by the aid of a pump from above the nigre through a skimmer and pipe, attached by means of swivel joint to a pipe fitted in the side of the pan; or the removal may be performed by gravitation through some mechanical devise from the side of the "copper." Of course every precaution is taken to avoid the presence of the "nigre" in the soap.

CRUTCHING.

The next thing to be done is crutching. This consists in stirring the hot soap in the frames by means of hand crutches until the temperature is sufficiently lowered and the soap begins to assume a "ropiness." Crutching may also be done in power driven, steam-jacketed crutches. These are cylindrical in shape, with a tapering bottom preferably, and steam jacketed for the sake of convenience. They are provided in the middle with a "stirrer" or an "agitator," which may be of any convenient form—either a vertical or horizontal shaft carrying several blades, or the agitator may take the form of an Archimedean screw. As mentioned in the previous sections, soap is placed in frames and allowed to cool for a certain number of days. As far as one can see the old method of cooling slowly in frames requiring several days, must under the pressure of modern competition die out. There seems to be only three good reasons why the old method has lasted so long. (1) The public estimates the amount of soap purchased by the size of the bar, not knowing that they are purchasing water at *3d.* per pound in some cases. (2) Partly dried soap does not dissolve in water as freely as the soap containing 30-60 per cent. of water. (3) Rapidly cooled soap is perhaps slightly inferior in texture and appearance to the one cooled slowly in frames.

SOAP COOLERS.

Before coming to a brief description of the different types of soap cooling machines, it is worth while to summarise the advantages and disadvantages of these modern soap cooling machines. By using these, one can avoid numerous cumbrous frames and the labour of handling them. There will be a great deal of saving in space. The rapidity of the conversion of finished soap into a saleable material means a great deal of saving, as the soap (=Capital) is not locked up for a long time. If the soap coolers have suitable dimensions—preferably capable of adjustment—then the bars and roads or slabs of soap may be cut up without any scraps being left over. An order can be carried out rapidly and the material delivered very quickly, if none in stock. The method of cooling under pressure is specially suitable as the soap slabs are then brighter and firmer and hence the soap may be richer in rosin and filling than would be possible if the soap is merely "cast" in the candle mould type of machine.* Therefore less solid fat and more liquid fat may be used. As all the ordinary soaps can thus be treated, except the cold process and mottled soaps, it may be confidently predicted that the old way of cooling in frames is doomed to extinction before long at all events in large works where a large variety of soaps are made. (Soft soaps are naturally out of the question in this connection.)

As against all these may be said that the cost of soap cooling machines is rather high; but this off-sets the cost of a number of frames. Some soap cooling machines can only make one kind of bar or slab which means a different machine for each size. Soap cooling machines require more skilful workmen than ordinary frames. As yet the public are not yet educated up to seeing that the product from the rapid cooler is just the same essentially as it would be if put through an ordinary frame, although it differs somewhat in appearance, texture and hardness, owing to difference in the rate of cooling. Of course, it rests with the manufacturer to convince the buyer that such soaps can do the same work as economically as the older make.

* In this the advantage scarcely rests with the consumer, but that is quite a different point.

Since the subject of soap cooling machines is a very important one in this industry, we cannot pass on without giving a brief description of the types of different machines now in vogue. All these are essentially the same in the fundamental principle of rapidly chilling thin layers of soap by means of cold water, in opposition to the old way of cooling in soap frames. CRESSONNIERE'S were the pioneers and their plant is largely used for toilet soaps. The soap flows into a jacketed mixture (colour may be added here advantageously), thence through a series of rolls cooled by water circulating in them, and afterwards passes in thin films over a series of endless gauze bands in a box warmed by steam pipes and fitted with a blower to renew the air. The soap leaves the box after about ten minutes holding about 10 per cent. of water, and ready for milling, etc. Another machine in use is the SCHNETZER-SCHICHT. It is best described as being built like a candle machine, i.e., the soap is cooled in water jacketed cylinders worked at 12-atmosphere pressure. Cooling water at 10-12°C and soap at 80°C it turns out 100 bars of soap weighing 3·3 lb. each (1·5 kilos) in 30 minutes per batch. Three men work two machines. Water required is only 0·5 cubic meter per 100 kilos of soap. JACOBI'S Cooler is built on the filter press model. It consists of a large steam jacketed pressure vessel, from the bottom of which a jacketed pipe leads to the cooler which consists of a number of wooden frames lined with polished nickel. These frames are sandwiched between hollow plates with polished nickel surfaces, cooled by a current of water, each plate having its own supply. Soap is admitted to the plates from below, air escaping from a small hole at the top of each. When filled compressed air at three atmospheres is put on to the pressure vessel and kept on till the soaps are solidified. Time required is about 40-50 minutes. The last two machines are slightly discontinuous, but on the whole give larger outputs. A continuous process has been suggested in which the soap is driven in a zig-zag direction vertically by a series of worms worked by gearing upwards and downwards alternately. The mass of soap is cooled externally by a water jacket, and internally by water passing through the axis of the worm. It passes directly into a plodder.

All the above are simple, occupy little space, save labour, increase output greatly and lower costs, especially interest on capital (soap) locked up in soap frames. Waste is also greatly reduced.

FINISHING PROCESS.

Before the soap is finally cut into slabs, bars and tablets, sometimes it will be necessary to add the various "fillers," and this is best performed in the crutchers to which reference has already been made. The bars are then cut into tablets, which are stamped in a machine. This machine is worked by hand, and is meant for stamping the bars into twin tablets or other form and is the one most used in all soap factories, except in those cases where automatic mechanical stampers are employed in particularly big works. This is the ordinary procedure for all household soaps. The manufacture of toilet soaps, however, is a little more complicated. In this case the soap which ordinarily contains 30-33 per cent. of moisture, is solidified on water cooled cylinders (one of the soap cooling machines described previously) and dried in hot air stoves until the moisture is reduced to 10-12 per cent. Subsequently it is milled between massive granite rollers in order to make it thoroughly homogeneous and smooth, and to allow the colour and perfume (synthetic and natural) being blended in order to suit the requirements of the market. The soap saturated with scent is now in "ribbons" and is ready to enter a machine called the "Plodder." This machine, by means of an Archimedean screw, squeezes the shreds of soap through a nozzle into a homogeneous whole delivering it in the form of one continuous bar, of the particular shape required. This bar is cut and shaped into tablets, which after receiving some finishing touches by hand, are packed neatly in attractive boxes.—THE MYSORE ECONOMIC JOURNAL.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Socotrine cwt.	Fair to fine	40/ a 50/
Zanzibar & Hepatic ,,	Common to good	40/ a 70/
ARROWROOT (Natal) lb.	Fair to fine	5d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£7 10/ a £7 15/
East Indian, bleached ,,	Fair to good	£8 10/a £8 12/6
,, unbleached ,,	Dark to good genuine	£6 5/ a £7
Madagascar ,,	Dark to good palish	£7 15/ a £8 2/6
CAMPHOR, Japan lb.	Refined	1/7 a 1/8
China cwt.	Fair average quality	155/
CARDAMOMS, Tuticorin	Good to fine bold	5/9 a 6/
per lb.	Middling lean	4/8 a 5/4
Malabar, Tellicherry ,,	Good to fine bold	5/9 a 6/3
Calicut ,,	Brownish	3/9 a 5/3
Mangalore ,,	Med Brown to good bold	4/ a 6/4
Ceylon, Mysore ,,	Small fair to fine plump	4/ a 6/4
Malabar ,,	Fair to good	3/2 a 3/4
Seeds, E. I. & Ceylon ,,	Fair to good	4/ a 4/3
Ceylon "Long Wild" ,,	Shelly to good	2/3 a 3/6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	50/ a 60/
Japan ,,	Fair bright small	60/ a 70/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜d a 7d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅛d a 4d
CINNAMON, Ceylon 1sts.	Good to fine quill	1/3 a 1/9
per lb. 2nds.	,, ,,	1/2 a 1/7
3rds.	,, ,,	1/1 a 1/6
4ths.	,, ,,	1/ a 1/3
Chips,	Fair to fine bold	2d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	1/ a 1/2
Amboyna ,,	Dull to fine	10d a 10½d
Zanzibar ,,	Fair and fine bright	5⅞d a 6¼d
Madagascar ,,	Fair	7d
Stems ,,	Fair	2d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	63/ a 80/
COCOA, Ceylon Plant. ,,	Special Marks	81/ a 88/6
	Red to good	73/ a 80/6
Native Estate ,,	Ordinary to red	42/ a 68/
Java and Celebes ,,	Small to good red	30s a 93s
COLOMBO ROOT ,,	Middling to good	15/ a 22/6
CROTON SEEDS, sifted ,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	130/ a 150/
GINGER, Bengal, rough ,,	Fair	19/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	35/ a 74/
Cochin, Rough ,,	Common to fine bold	22/6 a 27/
	Small and D's	20/
Japan ,,	Unsplit	20/
GUM AMMONIACUM ..	Ord. Blocky to fair clean	40s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
	,, ,, red	£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	26/ a 32/6
Turkey sorts ,,	,, ,,	37/ a 57/6
Ghatti ,,	Sorts to fine pale	17/ a 27/
Kurrachee ,,	Reddish to good pale	22/6 a 32/6 nom.
Madras ,,	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA ..	Clean fr. to gd. almonds	£6 a £6 10/
	com. stony to good block	40s a £5
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	57/6 a 67/6
Somali ,,	,, ,,	52s 6d a 55s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	35s a 40s
pickings ,,	Low to good pale	15/ a 27/6
siftings ,,	Slightly foul to fine	18s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	2/4
Ceylon, Straits, Malay Straits, etc.	Crepe ordinary to fine	2/2¼
	Fine Block	2/4¼
	Scrap fair to fine	1/8 a 1/9
Assam ..	Plantation	1/10
Rangoon ,,	Fair II to ord. red No. 1.	1/3 a 1/6
,,	,, ,, ,,	1/2 a 1/4

	QUALITY.	QUOTATIONS.
INDIA RUBBER lb.		
Borneo ,,	Common to good	9d a 1/3
Java ,,	Good to fine red	1/3 a 1/6
Penang ,,	Low white to prime red	9d a 1/4
Mozambique ,,	Fair to fine red ball	1/9 a 2/1
,,	Sausage, fair to good	1/9 a 2
Nyassaland ,,	Fair to fine ball	1/9 a 2
Madagascar ,,	Fr. to fine pinky & white	1/4 a 1/6
,,	Majunga & blk coated	1/ a 1/2
,,	Niggers, low to good	6d a 1/6
New Guinea ,,	Ordinary to fine ball	1/4 a 1/7
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	3s 3d a 3s 8d
,,	Consuming mid. to gd.	2s 9d a 3s 2d
	Ordinary to middling	2s 4d a 2s 9d
,,	Mid. to good Kurpah	1s 11d a 2s 5d
,,	Low to ordinary	1s 6d a 1s 9d
,,	Mid. to fine Madras	1/11 a 2/9
MACE, Bombay & Penang per lb.	Pale reddish to fine	2/4 a 2/6
	Ordinary to fair	2/ a 2/2
Java	,, ,, good pale	2/1 a 2/4
Bombay	Wild	1/
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	9½d a 10½d
	80's	7½d
	110's	6½d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20/
NUX VOMICA, Cochin	Ordinary to good	13/6 a 15
per cwt. Bengal	,, ,,	12/
Madras	,, ,,	12/ a 13/
OIL OF ANISEED lb.	Fair merchantable	5/2
CASSIA ,,	According to analysis	2/8 a 2/11
LEMONGRASS oz.	Good flavour & colour	2¼d
NUTMEG ,,	Dingy to white	1½d a 1⅝d
CINNAMON ,,	Ordinary to fair sweet	4d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/6½
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	5d
Ceylon ,, ,,	Fair to fine bold heavy	5d a 5⅝d
Singapore ...	Fair	4⅝d
Acheen & W. C. Penang	Dull to fine	5d a 5½d
(White) Singapore ,,	Fair to fine	8½d a 8¾d
Siam ,,	Fair	8½d
Penang ,,	Fair	7¾d
Muntok ,,	Fair	9d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 4/
Canton ,,	Ordinary to good	1/10 a 3/6
High Dried ,,	Fair to fine flat	11d a 1/1
	Dark to fair round	9d a 10d
SAGO, PEARL, large—cwt	Fair to fine	18/
medium ..	,, ,,	16/
small ..	,, ,,	13/ a 14/
Flour ..	Good pinky to white	10/ a 11
SEEDLAC cwt.	Ordinary to gd. soluble	65/ a 75/
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 8½d
	Fair greenish	3d a 4½d
	Common specky & small	1½d a 2½d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	72/6 a £6
Bombay ,,	,, ,,	85/ a £6 10/
Mergui ,,	Chicken to bold	£8 12/6 a £145
Manilla ,,	Fair to good	£7 17/6 a 13 10
Banda ,,	Sorts	50/ nom.
Green Snail ,,	Small to large	70/ a 85/
Japan Ear ,,	Trimmed selected small to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	14/ a 15/
per cwt. Madras	Inferior to good	6/ a 10.
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	12/ a 26/
	Pickings	6/6 a 19/
TURMERIC, Bengal cwt.	Fair	12/ a 13/
Madras ,,	Finger fair to fine bold bright	14/ a 16/
Do. ,,	Bulbs ,, ,,	12/ a 13/
Cochin ,,	Finger fair	13/ nom.
	Bulbs ,,	11/6 a 12/
VANILLOES— lb.		
Mauritius ... 1sts.	Gd. crystallized 3½a 8½ in.	9/6 a 15/
Madagascar ... 2nds.	Foxy & reddish 3½a ,,	9/ a 12/
Seychelles ... 3rds.	Lean and inferior	9/ a 9/6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares cwt.	Good white hard	47/6

OPENING OF THE SCHOOL OF TROPICAL AGRICULTURE, JANUARY 15, 1916.
GROUP TAKEN IN FRONT OF THE DIRECTOR'S BUNGALOW, PERADENIYA.

2nd Row, left to right: T. H. Parsons; L. E. Campbell, G. Bryce, H. F. Macmillan, H. L. De Mel, Hon. Mr. C. S. Vaughan, R. N. Lyne, Hon. Sir Anton Bertram, Hon. Mr. A. S. Pagden, C. Drieberg, J. Harward, M. K. Bamber, D. S. Corlett, St. L. H. de Zylva, J. J. Nock.

3rd Row, (from No. 8): H. L. van Buuren, L. B. Kapuwatte, N. Wickremaratne, R. H. Pereira, H. A. Deutrom, G. M Henry, G. E. J. Hulugalle, W. P. A. Cooke, L. S. Bertus, J. E. Lobendhan, J. C. Drieberg.

Students in khaki and helmets.

THE

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OVER-IRRIGATING RICE.

At the Meeting of the Board of Agriculture at Galle on November 30th last considerable interest was taken in Mr. Corlett's description of the system of water control established by him on the paddy fields of the Experiment Station, Peradeniya, and of the satisfactory results that have been so far achieved. Mr. Corlett has introduced from Egypt several departures from established Ceylon practice among them being dry ploughing and green manuring between crops. The seed sown on the experiment plot was from that evolved by Dr. Lock, carefully selected each year since it was first introduced; only plants with 15 or more stems to a stool being set apart for seed. In previous years this method of selection has not produced any very striking effect; time is required for that. The wonderfully good crop that has been produced at Peradeniya must be set down mainly to the fact that the irrigation water has been kept under control and the land has not been allowed to become water-logged.

In his paper on the Irrigation of Rice in Ceylon read before the Ceylon Agricultural Society on May 25th, 1915, Mr. Balfour stated that according to experiments carried out by him in the North-Central Province a three-months' crop of paddy required in one case 41 inches and in another 47 inches of water, and that from these and other data it appeared that on average paddy lands 16 inches were required for the first month and 12 inches for each succeeding month. In his excellent series of articles on the cultivation of Paddy in Ceylon during the nineteenth century which appeared in this Journal in 1912-14, Mr. Elliott did not, it is to be regretted, go into this question of quantity of water required, so important to the villager. His views on the amount of water used by the cultivator as

compared with the amount required would have been valuable. Generally speaking, more water is used by the villager on his paddy field than is necessary for crop nutrition, with the result that the land gets water-logged and hence soured. Good irrigation postulates a system of drains as well as of canals, but the paddy fields of Ceylon are not drained in the proper sense of the word. A breach is made in the bund and the water led off the surface, but that in the body of the soil does not escape. At Peradeniya a drain 20 inches deep is cut through the field from the top to the outlet. The water from the soil is drained away to a corresponding depth, its place being taken to a great extent by air from the atmosphere which contains oxygen, necessary for the process of plant nutrition. This is really the secret of the success of the Peradeniya fields. When water from beneath the surface cannot drain away oxygen from the atmosphere cannot enter, nitrification and plant nutrition is arrested and the paddy turns yellow—an unfailing indication of water-logged land.

The yield of the Peradeniya field in the corresponding period of last year was at the rate of 33 bushels per acre. The crop this year has not yet been threshed but the yield is estimated at 50 bushels, 50 per cent. more than that obtained from the land before the present system of canals and drains was introduced. During the first two weeks, when the crop was young, water was allowed to stand to the depth of 2 inches, being renewed every 2 or 3 days as it soaked in; if it had not disappeared in 3 days it was drawn off. Thus for the first fortnight 4 to 6 inches of water a week was used. After that water to the same depth was allowed to stand 6 days when it was drawn off and the land given a day to dry. This is repeated till within about 6 weeks of harvest when the drying interval is extended to 3 days alternating with 3 days water. Thus after the first fortnight water is never allowed to stand more than 2 inches deep; during the subsequent 3 months (with a 5-months' crop as this is) the land is left without water one day a week; after that for half the time the crop has no standing water at all.

Ceylon practice varies, so it is not possible to describe in a short article the systems of water control in vogue, but we believe there is nothing that corresponds to the system of drainage and dry intervals outlined above. The cry of the villager is for more water and in some cases no doubt there is a genuine shortage; but more often his necessity is in reality for more air.

R. N. L.

RUBBER.

A NEW BULLETIN ON RUBBER TAPPING.

We have received the Federated Malay States Department of Agriculture Bulletin No. 23 on "The Tapping of the Para Rubber Tree" by MR. E. BATESON, which Bulletin contains so much of interest to those who study the technical problems connected with rubber tapping that it is desirable to discuss it at some length. In a short preface MR. LEWTON BRAIN remarks that the delay in publishing is due to MR. BATESON'S absence from the country and the consequent difficulties in correspondence and correcting proofs. Doubtless to these difficulties is also due the fact that the Bulletin in question, though appearing late in 1915, bears as year of publication the date 1914, though it is desirable that publications such as these should bear the actual date of issue. The Bulletin is of especial interest in that a large amount of the work described therein is upon similar lines to work recently carried out in Ceylon.

MR. BATESON'S work covers a large area, perhaps too large an area to be fully dealt with in one Bulletin. The investigations are divided into six main sections, dealing with the effect of tapping on the starch reserves, effect of leaf change on the starch reserves, lateral transport of food in bark, tapping systems, theory of tapping and finally a section on "some practical considerations as regards the effect of tapping on the starch reserves." MR. BATESON came to the conclusion that "if any depletion of the starch reserves is caused by tapping, it is small in amount and temporary in duration."

In this, the work is in fair accord with results obtained in Ceylon by the writer of this article, and MR. BATESON after describing the investigations of FITTING'S remarks that he finds it hard to understand how FITTING obtained his results. Many of FITTING'S theories have now been proved to be fallacious by three independent investigators, namely SIMON, BATESON and the writer.

MR. BATESON concludes this section by rejecting FITTING'S suggestion that an examination of the starch reserves would be a useful method of determining when trees are ready to be retapped after the whole of the original bark has been removed. As a result of his investigations MR. BATESON concludes that "such examinations are unnecessary and that the thickness of the renewed bark forms a perfectly safe criterion."

With regard to the effect of leaf-change on the starch reserves, MR. BATESON remarks that the facts elicited by his research are somewhat too meagre, on account of the small number of trees examined, to enable precise conclusions to be drawn on the points of theoretical interest. He deduced, however, that in the Federated Malay States the effects of wintering are spread over such a long period that they merely form part of the general problem of devising a method of tapping, which, over a period of years, will not be so exhaustive to the tree as to check its full and natural development. The writer of this article is inclined to question the value of these deductions in that MR. BATESON apparently examined his trees at only quarterly intervals,

Now in Ceylon we examined trees throughout the year at monthly intervals, and during the period March 12th—May 7th, no less than six or seven sections were taken from each tree. By thus carefully following the various changes attendant upon fall of the old leaves and formation of the new, we found that a considerable depletion of reserve starch occurs on the formation of new leaf, which depletion is, however, only of short duration, fresh reserves being rapidly formed by the new leaves and accumulating up till May—June, after which the supply fell again somewhat until October. Had we contented ourselves by taking sections in say March, April, July, October we should have come to the same conclusion as MR. BATESON, who however, somewhat disarms the critic by remarking in a footnote (page 9) that "it would have been better if several trees could have been examined in all stages of wintering, viz : before the leaves were shed, when the trees were bare and after the new foliage had developed. This, however, would have meant taking the first specimens of wood and bark from an inconveniently large number of trees, as it was not then known which would winter." We hope that detailed investigations of this nature will be forthcoming from the Federated Malay States.

It is of course quite possible that the changes taking place in trees in Ceylon will differ widely from those taking place in trees in other parts of the tropics. With regard to lateral transport of food in bark the experiments showed that lateral translocation of food is possible.

In all his tapping experiments MR. BATESON describes only three systems, namely the single-quarter system with two cuts on one quarter, the adjacent quarter system with one cut on each of two quarters, and the opposite quarter system with one cut on each of two quarters. He found that the bark of the trees tapped by the adjacent quarter system contained more starch than the bark of the other trees, and that the thickness of renewing bark was greater. With regard to rubber yield the single-quarter system was better by 16% and the adjacent quarter system by 31% than the opposite quarter system, while the adjacent quarter system yielded 13% more than the single-quarter system.

There is much of interest in the final section of the pamphlet. MR. BATESON states that in his opinion there is no doubt that if trees growing in a soil of average fertility are allowed sufficient space, four years will be found quite long enough for bark renewal.

MR. BATESON's remarks on thinning-out, burr-formation, etc., are of such interest that it is desirable to discuss them at length in the next issue of this Journal.

L. E. C.

(To be continued.)

MR. L. C. BROWN of the F.M.S., writing about coconut planting, says :—"I may mention, after my long experience of the coconut industry, that to produce really healthy and productive trees I consider the most critical stage of the plant is in its earlier life, i.e. from infancy up to the 3rd or 4th year, and during this period the most careful attention must be exercised."

COFFEE.

ROBUSTA COFFEE IN JAVA.

Coffea Robusta is now the favorite Dutch East Indian crop, and it is being freely prophesied that many fancy growths are doomed to extinction because of its advent. "Considerable variation is to be found in the opinions expressed as to the quality of Robusta coffee," says Tropical Life, "but it is not improbable that such differences are in some measure to be explained as a result of different methods of preparation, not all of equal excellence. It is stated that the beans do not possess a first-class color, and that for the first two crops a good aroma is lacking. Dr. Wildeman affirms that the flavor recalls that of Liberian coffee, but with less aroma. Hart compared Robusta coffee of Costa Rica and the East Indies; while, according to Cramer, the quality of well-prepared Robusta coffee is approximately that of middling Arabian coffee. The beans possess a bluish green color, similar to that of the Arabian product, but they are of a somewhat different shape being larger and more convex on the curved side."

Writing on the subject of Robusta coffee (*Coffea canephora*) in the Philippine Agricultural Review, P. J. Wester strongly recommends the growing of this variety of coffee in altitudes of under 1,200 feet. It is much superior to Arabian coffee in its yield; it is an early as well as a prolific bearer, and is more resistant to blight. Although the flavor of Robusta coffee is stated to be inferior to that of the Arabian variety, Mr. Wester considers that this alleged defect is not sufficient to counterbalance its general advantages.

Coffea robusta, Dr. Cramer considers to be identical with *Coffea laurentii;* this species is as distinct from *Coffea arabica* and *Coffea liberica* as these are different from one another, and requires conditions quite other than those needed by these for its proper growth. In the history of the distribution of the species it was first obtained from Brussels in 1900 for planting in the east and centre of Java, where it was considered as a curiosity until two years later, when its large power of production came under observation. Since 1907 there has been a great extension of the area of *Coffea robusta* in Java. No other kind of coffee is being planted at present to any extent in Java or other islands in the Dutch East Indies.

Experiments in Java show that this coffee will flourish from sea-level to an altitude of 3,000 feet. The best plantations are found in the humid districts of East Java, where there is a large rainfall distributed equally during the year. These estates are situated from 1,000 to 1,500 feet above sea-level, and the soil is deep and rich in vegetable matter. The plant is capable of resisting drought to a certain degree, but prefers an abundant and regular rainfall. In the south of Java it has survived a dry period lasting nearly four months; the trees suffered to some extent, but recovered very quickly after the first rain. In Java, Robusta coffee is always planted under shade; in

connection with this, the shade given by Para rubber trees would be insufficient on account of its inequality and its absence for part of the year owing to the loss of the leaves. The plant suffers severely if exposed to the wind, and where such exposure is likely to occur it is useless to attempt to grow it unless measures are taken for its protection.

TIME OF FLOWERING AND YIELD.

The first flowering takes place a year after planting, though cases are known in Sumatra when the period has been eight months; in the latter case sterile flowers were formed after seven months, and the normal flowers appeared a month later. After flowering, the time for the formation of ripe fruits may be taken as nine months; thus trees of the latter kind would yield a harvest in two years. The plant flowers during the whole of the year resembling *Coffea liberica;* nevertheless, the climate has some effect on production, and the crop is increased in amount during the dry season; the berries remain on the branches for about a month, so that a monthly picking is necessary.

The berries are smaller than those of Liberian coffee, and are borne in thick bunches, so that picking is facilitated and hastened. The fruit covering is thin, and there is another advantage in that the skin is easily removed. The seeds are fermented for thirty-six hours and then washed and dried; for the last-named purpose they should be exposed immediately to a temperature of about 60 degrees C. The seeds are slightly different in shape, being larger and more convex than those of Arabian coffee. The bulk is about the same.

HOW COFFEE IS CULTIVATED.

Coffee in Netherlands East India is mostly grown on an elevation above sea level varying from 1,000 to 3,000 feet, though sometimes plantations exist higher than 3,000 and lower than 1,000 feet. It is not a plant for an obdurate soil; it thrives best on a loose, virgin soil, rich in decomposed organic matter and in a climate having a moderate, regular rainfall.

The ordinary procedure in Netherlands East India is to procure some forest or jungle having an area of at least 1,000 acres, which is felled, burnt and cleared so as to prepare it for planting. Nurseries have to be made for the coffee seedlings. Temporary houses have to be erected for the labour force, the manager and his staff. Roads have to be constructed. The cleared land, when ready for planting, is divided into regular squares or blocks, and these blocks are carefully lined so as to obtain regular rows when planted. At regular distances along these lines planting holes are dug deep enough to secure thorough aerating of the soil. Stones, roots and other obstructions found in the soil taken out of these holes have to be removed before the soil is returned to the holes. These refilled holes are to receive the seedlings. The transplanting of the seedlings is a painstaking and therefore a rather slow work. Hurrying it up would possibly avenge itself in aftertime, for now the plants, as far as their roots are concerned, have to take care of themselves. As a protection for their leaves the coffee trees are interplanted with shade trees, for which *Leguminosæ* are chosen, in view of their capacity to fix nitrogen from the air. Planted at the same time as the coffee seedlings, and growing quicker than these, they will, when grown up, afford the coffee trees shade protection and act as wind-breaks.

WEEDING AND PRUNING.

In order to make the young coffee fully benefit by the fertility of the soil, clean weeding must be strictly adhered to, this system of weeding having at the same time the charitable effect that the soil is kept loose and well ærated. This, of course, involves continual expenditure for labor, etc., during the first three years.

When reaching the height of some 7 feet the tree is topped at about 6 feet from the ground, and kept at this height by regular pruning, it only being allowed to gradually renew itself by shoots from the rootcrown. The trees, when topped, are expected to strengthen and thicken their stems and their system of branches, these latter being their organism for fruit bearing. In consequence of this method of cultivation the coffee trees soon become bigger, and the thin, wide files now fill themselves to a dense, leafy mass covering the soil 6 feet high. In this period the tree's energy in making boughs, shoots and leaves has to be checked and directed into its fruit-bearing capacity, so the pruning knife comes into play.

THE RIPENING PROCESS.

Fruit bearing in normal conditions begins in the third year. The ripening process takes eight to nine months.

Liberian coffee bears fruits of the largest size, Robusta of the smallest size, and *Coffea arabica* fruits of a size ranking between these two. The various kinds of coffee are distinguished from each other by the color and the size of the kernels and the thickness of the outward peel. The color of Liberian coffee, when prepared, is yellowish-white, that of *Coffea arabica* bluish-green, and that of Robusta coffee grey. The peel is thickest and least elastic with Liberian coffee, thinnest and most elastic with *Coffea arabica*, and medium thick and elastic with Robusta coffee. With all three kinds it shows the state of ripeness of the fruit by assuming a fresh, red color.

PICKING AND PREPARATION.

As soon as the red color appears the crop is gathered and taken to the factory.

This factory consists of one or more iron-roofed sheds containing the necessary machines for pulping, washing and hulling the coffee. It has drying floors and a hot-house and godowns for storing the coffee. First of all the berries are pulped mechanically by means of compression between a system of revolving disks or drums under continuous supply of water, the water which flows off removing the empty peels, whereas a stream of fresh water washes the separated coffee beans into a tank. In this tank the beans are kept with a view to submitting them to a fermentation process. When separated from the peel the beans have a slimy appearance. This slime, which covers the parchment shell of the kernel, is decomposed by means of fermentation for a time, varying from 24 to 48 hours, depending on temperature and other circumstances. The duration of this fermentation process is controlled by tests.

The next process is to remove the last traces of the pulp and to get the beans in their parchment shell clean from dirt and waste, for which purpose the fermented coffee beans are washed by clean water into another big tank, where they are raked and kept in constant movement in clean water for

some hours until all adhering substances are separated and the kernels feel rough and harsh. Then the wet coffee is spread into a thin layer on cemented floors in the open air, sun and wind being utilized to evaporate the remaining moisture. This part of the work is often very tedious; firstly, because there is not always sufficient sun and wind for this purpose and, secondly, because the parchment shell which enclosed the kernel, as well as the kernel itself, is very difficult to dry. Therefore, a hot-house to dry coffee with heated air cannot be dispensed with. The necessity of a supplementary artificial drying apparatus imposes itself the more stringently because coffee cannot be stored before it is absolutely dry. Discoloration and deterioration are unavoidable when coffee is stored before being perfectly dry.

The next procedure is that the parchment be removed by hulling and fanning simultaneously. It may be remarked here that the native preparation does not include this treatment, as the natives simply pound their coffee with heavy poles in big troughs. After the hulling, the sifting and sorting take place in accordance with the requirements of the coffee trade. The sorting is done to size and color, and some sorts of coffee, such as Sumatra and Menado, are then stored and kept sometimes for one or several years. During this storing period the product must be from time to time turned over by means of rakes, but it must be borne in mind that by keeping the coffee in store the color fades and small boring insects often attack the product. However, storage improves the flavor and consequently increases the value.

THE COMMERCIAL POINT OF VIEW.

From what was said above it appears that planting coffee in Netherlands East India is a costly scheme. Not taking into consideration the purchase price of the land, the average cost of bringing 1 acre into bearing is estimated at $100.

The yield depends for coffee, more than for any other tropical product, on weather and temperature.

Robusta coffee guarantees a crop exceeding the yields of other coffees so far cultivated in Netherlands East India.

Notwithstanding its trade reputation as being of a lower grade, and consequently fetching lower prices than other coffees in the market, the greater security it affords the planter in view of the bigger crops predisposes this coffee, considering all circumstances, to be a desirable cultivation for Netherlands East India.—Extracts from a paper by BARON SALAK in the TEA AND COFFEE TRADE JOURNAL.

VEGETABLE PAINT.

In certain parts of Uruguay the farm buildings are a fine white colour, even during the wet season. To obtain this neat effect a whitewash is used, made from the sliced "leaves" of the Prickly Pear, which, when macerated in water for twenty-four hours, produce a solution of creamy consistence. To this lime is added and well mixed in. When the solution is applied to any surface, be it wood, brick, iron, or other material, a beautiful pearly white appearance is produced, which endures through rains and frosts for many years.

RICE.

RICE GROWING IN BRITISH GUIANA.

British Guiana, a few years ago, was a conspicuous example of a colony with only one important agricultural industry; in addition to sugar and its by-products there were no other exports, except a small amount of cacao, obtained by cultivation. To-day sugar easily maintains its premier position, but there is also an important rice industry yielding sufficient to supply the large local demand and to leave a considerable and increasing surplus for export. So promising is the industry that hopes are entertained that British Guiana, in the not distant future, may become "the granary of the West Indies." Before entering into any details regarding the change which has been effected in British Guiana it will be well to refer briefly to developments in other parts of the world.

Rice, the staple foodstuff of more people than any other cereal, is native to south eastern Asia. For many centuries the countries to which it is native and the adjacent regions maintained a monopoly of the cultivation; they are still far ahead of all competitors. Other countries, however, are steadily increasing their rice output, and some which at one time imported the grain now raise sufficient to leave a surplus for export.

Various causes have contributed to this result. In the United States rice was introduced some 250 years ago. For a long time Carolina and Georgia remained the chief producing regions, the crop being grown and harvested under conditions not differing essentially from those obtaining in Asia. The swampy lands forbade the use of labor-saving machinery and the crop could not be produced at as low a rate as where cheap tropical labor is available. In about 1880 prairie regions in Louisiana and Texas were opened up, and by extensive irrigation works land, normally dry, is artificially flooded so as to permit of growth of rice. By subsequent withdrawal of the water the crop is harvested under conditions permitting of the use of modern machinery. The economy thus effected, together with the introduction of improved varieties, revolutionised rice cultivation in the States, and Louisiana and Texas now produce 80 to 90 per cent. of the rice crop of the country, which in 1908 amounted to some 301,786 tons, or about 75 per cent. of the total consumption, whereas prior to 1880 the proportion was only about 60 per cent. of the then much smaller consumption. Rice production in the United States has much more than kept pace with the growth of the demand.

Rice was introduced into British Guiana from Georgia in 1853. It did well, and some of the crop was sent to England, where, as cleaned rice, it realised 30*s*. per cwt., or 5*s*. more than the ordinary Carolina rice at the time. A subsequent introduction appears to have been made from Carolina in 1865. An industry began to grow up and a company was formed, but owing to large crops in India, combined with a local scarcity of labour, the venture proved unremunerative.

The cultivation lingered on until, in 1902, a shortage of Indian rice, with a consequent rise in price, gave it an impetus, and the area under cultivation was increased.

A trustworthy indication of the material progress of the industry may be gathered from the trade returns. As recently as 1895-6 rice was imported to the extent of 22,000 tons, valued at £183,394. This has been largely dispensed with, and in addition to meeting the large local demands rice began to be exported in 1902-3, when about 500 tons, worth £60 left the colony; in 1908-9 the export was 3,115 tons, of the value of £59,037, and this year, the complete figures for which are naturally not yet available, the exports to date show a considerable increase on those for the corresponding period of last year. The rice exported goes chiefly to the British West Indian Islands and some to French and Dutch Guiana.

The general outlook for the industry is full of promise, although there is always the possibility that heavy crops from India may drive prices below the remunerative point. Last year the export was affected by the presence in the West Indian markets of cheap East Indian varieties.

The utilisation of by-products has not been neglected, and rice meal, and also the husks saturated with molasses, forming an excellent cattle food, are exported in considerable amounts.

British Guiana is at present the greatest rice-producing country in South America. Peru produces nearly as much, and the Argentine also has an extensive industry. In British Guiana, however, rice cultivation is making great strides, and there is every prospect that an important industry will be permanently established, and that within the next few years the colony may attain much greater importance as a source of rice both for itself and for the neighbouring countries; *especially if experiments in hand in cultivating and harvesting the crops by mechanical means should prove successful.* The quality of British Guiana rice, it should be noted, is very high. The choicest, the "Berbice Creole," appears to be excelled only by Carolina Golden Grain, the best of all rices, and if care is taken to maintain the standard and to meet the requirements of the market in the mode of preparation British Guiana rice may win a place for itself in the markets of Europe.—THE TIMES.

RICE PRODUCTION IN BRAZIL.

ALFRED L. M. GOTTSCHALK.
RIO DE JANEIRO.

The growing importance of the rice production of Brazil, and the fact that the country is rapidly learning to support itself in this important foodstuff, are shown by the gradual decrease through the years of Brazilian imports of rice. The more recent changes are indicated by the figures for 1913 and 1914, with the respective quantities and values for each of the countries from which Brazil imports rice. These figures, with the weights given in kilos of 2·2046 pounds each, are given in the accompanying table.

Countries of Origin	1913		1914	
	Quantity, Kilos	Value	Quantity, Kilos	Value
Germany	758,679	$76,183	202,880	$17,479
United States	10,375	1,268	2,798	325
United Kingdom	247,782	23,825	21,234	2,132
Netherlands	123,185	12,668	235,162	17,661
India	5,538,991	539,066	4,508,983	362,333
Other countries	1,098,349	91,106	1,563,976	119,469
Total	7,777,361	744,116	6,535,033	519,399

Changes during a period of five years are indicated by the quantities imported annually. In kilos the amounts were: In 1910, 17,320,437; 1911, 16,532,262; 1912, 10,226,254; 1913, 7,777,361; 1914, 6,535,033.

STATISTICS OF PRODUCTION IN TEN STATES.

Recent statistics of the rice production of the several States of Brazil are not available. The latest, for 1910, in liters of 0·9081 quarts each, are: Para, 200,000; Maranhao, 971,000; Parahyba, 1,950,000; Ceara, 2,730,000; Espirito Santos, 24,000; Rio de Janeiro, 11,323,000; San Paulo, 62,555,000; St. Catharina, 1,820,000; Rio Grande do Sul, 2,925,000; Minas, 28,463,000.

Later returns when received will undoubtedly show large gains in the Brazilian production of rice, the domestic article gradually displacing the imported product. This follows in line with a movement noticeable in certain parts of the country to diversify crops, and to make certain regions produce their own supplies of foodstuffs formerly imported from abroad.—TEA AND COFFEE TRADE JOURNAL.

RICE GROWING.

THE PHILIPPINE PLANTER for November last has been kindly sent to us by the Editor (MR. A. W. PRAUTCH) and entirely proves its claim as "a progressive agricultural journal." Though of modest "get up" the magazine is full of interesting information. Among other subjects discussed is that of rice growing by MR. FRANK PERRIN.

The writer points out the importance of the fact that the prime necessity for successful cultivation is the possibility of absolutely controlling the water supply and the flooding of the fields. While the rice plant thrives and grows to maturity with its roots and a part of its stalks immersed, it is as easily damaged by flood and ruined by drought as any other grain crop. The conditions are most favourable where water can be easily procured, where all danger of flood is minimised and where the water could be drained from the field at the proper time.

In the West where cultivation has reached a high level, the ground is prepared in exactly the same manner as for wheat or any other cereal before drilling; then follows the necessary irrigation; after which (when the crop has sufficiently matured) the lands are got dry enough to admit of harvesting machines being used.

American rice is said to be superior to that grown in the Orient, and there is reason for this since the American farmer employs the most scientific methods while the eastern cultivator has to make the best of natural conditions, which are not always favourable with his primitive ideas and appliances.

GREEN MANURING RICE.

G. C. SHERRARD.

A green manure is a crop grown on land and afterwards ploughed into the place where it has been grown, that is, it is buried in the soil, where it decays and provides food for the next crop grown there. There are many occasions when it may be advisable to apply such a manure, and it is of course usually more advantageous when the growth of the green manure crop does not stop the owner of the land from growing any other crop that he would usually take off the land.

It is not the purpose of this article to explain exactly why or how burying a lot of green plants in the land can benefit another crop grown on that land ; it is enough to say that plants feed on things that they take out of the soil just as much as men live on things that they eat, and that under certain circumstances plants growing in the ground can indirectly get a lot of nourishment from other plants that have rotted in the ground. I here wish to tell you some of the results that have been achieved in Bihar from giving a green manure to rice.

First of all, however, I will explain how this green manuring is done. It is very easy. As early in the rains as possible, that is to say usually about the time the rice seed is sown, the land to be green manured should be ploughed and cultivated and then sown with either san-hemp or *dhaincha*,* the amount to sow is 30 pukka seers per acre of san-hemp, and 15 seers of *dhaincha*. The cost of this cultivation and sowing is very light even if the cultivator is not able to use his own bullocks, which in most cases he would be able to do. Whichever crop is sown, it is left to grow until the time comes to puddle the land. Before puddling a *chowki* or wooden beam should be driven through the crop to break it down, and the land is then puddled in the ordinary way except that it is usually necessary to drive the plough round rather more times than in land which has not got a green manure crop in it. All the green manure should be mixed with, and buried in, the mud. The seedlings are then transplanted. It is better if a week elapses between the time when the green manure is ploughed in and the rice transplanted.

The following results are those obtained on farms in this Province by this treatment. Two plots of land were taken and treated in exactly the same way except that one was green manured and the other was not, that is to say, the same rice was transplanted at the same time on each plot, etc.

AT THE DUMRAON FARM IN NORTH SHAHABAD.

Year.	Kind of green manure ploughed in.	Weight of grain per acre from the green manured land.		Weight of grain per acre from the unmanured land.		Increase per acre due to the green manure.	
		Mds.	srs.	Mds.	srs.	Mds.	srs.
1908-09	San-hemp	29	0	22	20	6	20
1908-09	*Dhaincha*	25	0	22	20	2	20
1909-10	San-hemp	31	30	21	10	10	20
1909-10	*Dhaincha*	34	0	21	10	12	30
1910-11	San-hemp	26	5	20	0	6	5
1910-11	*Dhaincha*	36	10	20	0	16	10
1911-12	San-hemp	20	0	15	25	4	15
1911-12	*Dhaincha*	28	20	15	25	12	35
1912-13	San-hemp	14	10	9	25	4	25
1912-13	*Dhaincha*	13	30	9	25	4	5
1913-14	San-hemp	19	30	15	25	4	5
1913-14	*Dhaincha*	23	12	15	25	7	27

* *Sesbania aculeata.*

AT THE BANKIPUR FARM IN PATNA.

Year.	Kind of green manure ploughed in.	Weight of grain per acre from the green manured land.		Weight of grain per acre from the unmanured land.		Increase per acre due to the green manure.	
		Mds.	srs.	Mds.	srs.	Mds.	srs.
1910-11	*Dhaincha*	26	11	15	15	10	36
1910-11	San-hemp	27	30	17	20	10	10
1910-11	*Dhaincha*	26	33	17	20	9	13
1910-11	*Ditto*	26	1	16	10	9	31
1910-11	San-hemp	27	22	16	10	11	12
1910-11	*Dhaincha*	27	7	16	10	10	37
1911-12	*Ditto*	30	22	19	3	11	19
1911-12	San-hemp	31	7	21	1	10	6
1911-12	*Dhaincha*	30	7	21	1	9	6
1911-12	*Ditto*	34	35	20	10	11	25

AT THE CUTTACK FARM IN ORISSA.

Year.	Kind of green manure ploughed in.	Weight of grain per acre from the green manured land.		Weight of grain per acre from the unmanured land.		Increase per acre due to the green manure.	
		Mds.	srs.	Mds.	srs.	Mds.	srs.
1906-07	*Dhaincha.*	12	20	10	10	2	10
1907-08	do	29	0	22	20	6	20
1908-09	do	35	20	30	0	5	20
1909-10	do	26	0	19	0	7	0
1910-11	do	29	20	22	10	7	10
1911-12	do	31	0	28	30	2	10
1912-13	do	29	27	28	11	1	16
1913-14	do	22	12	17	27	3	25

From the above tables it can be seen that this practice of ploughing a green crop into the land before the rice is transplanted has actually resulted in a larger yield of rice. Some further notes on this subject will be given in the next issue of this journal.—Agric. Journal, Bihar & Orissa.

TOBACCO.

TRANSPLANTING TOBACCO.

See that your seed-bed is well moistened before the plants are pulled, and that care is taken not to harm the rootlets, or, in fact, any part of the plant when removing it for planting out. HOWARD, in India, tells us: "When removing your plants use a pointed skewer, either of bamboo or iron, about the thickness of a lead pencil. This should be pushed into the seed-bed to a depth of about 3 in. at intervals of every 3 or 4 in. When about to remove the plants well water the bed, and leave it for about three hours whilst the water percolates through various holes and gets down to the roots, then apply the 'progger' and get to work." Having reminded you of this, we now come to that important stage in the life-history of the tobacco-plant, i.e., transplanting.

From reports to hand it seems that, although transplanting is still done by hand as a rule, machines, any rate in America, are used to a considerable extent, and, according to HARPER, tobacco can with their aid be set out in dry weather and a good stand obtained. The great thing to aim at throughout is to produce plants as uniform as possible in every way, i.e., in texture, growth, height of plant, size of leaf, and last, but not least, in rapidity of growth—plants that take a long time growing are no good as profit-makers. The growth of the plant, according to MR. and MRS. HOWARD, has to be completed in two months' time, viz., from the middle of October (that is in Behar), when the young plants are established, till the middle of December, when their growth is checked by the cold. Any late-set-out plants, which miss this period of growth, are always behind the rest and invariably give a diminished yield. Further, their presence renders the product un-uniform, so that the fields cannot be cut and cured at one time.

Lack of skill in raising and transplanting the seedlings goes a long way to discourage, if it does not directly cause lack of uniformity in the crops, and owing to this lower prices are given for the tobacco when the leaves come to market.

Referring to the suggestion that when moving or withdrawing the plants from the seed-beds, one should make a metal or wooden implement, first to loosen the earth round the plants, and then to push up the seedlings, KILLEBREW tells us much the same when he says: "The most careful hands are set to work to draw the plants from the beds. Carelessness and neglect at this stage are certain to tell seriously on the results of the crop. In removing the plants, wet the bed thoroughly unless this has just been done by a good rain, then take a common two-tined fork or a stick sharpened to a point at one end, run this gently down by suitably-sized plants and, first loosening them, then gently prise them up."

Leaving the nurseries with the young plants ready for removal, let us turn our attention to the field in which the plants are to be set out and where they will have to remain until removed to the curing barns. Here we cannot

pretend to coach up our readers as they need being coached if they wish to be successful. All we can say now is that the fields must always have an adequate, but never an excessive, supply of water, and it must always be up to the mark as regards plant foods, i.e., suitable and sufficient manuring. As regards the latter, the planter must remember that more care is necessary in the selection of the manures for tobacco than for any other crop, since everything you want in the leaf depends for their being upon what is taken up by the plant out of the soil. And as care must be taken to get the right formula for the manure, so is it equally necessary to get the right quantity of water; if there is no need to insure your fields against drought, all the better for you. It is, however, wonderful to note how many tobacco-producing centres are obliged to have some method for supplying water to the crop when Nature fails to do so. At the same time trouble is equally likely to come if a surplus quantity is supplied, for the excess makes the leaf darker and heavier and spoils it in the pipe or cigar. Irrigation is a great aid in getting a good "stand" of plants when the ground is dry at transplanting. When a new, up-to-date book is written on tobacco planting we hope the author will take us out into the fields and tell us how to break-up, plough, harrow, and generally prepare the ground for the final setting-out of the plants, discussing which make of plough is the most suitable, and whether there are any special ways of ploughing the fields according to the lay of the land and the variety to be raised.

KILLEBREW and MYRICH discuss the preparation of the land according to the variety of tobacco, but what they tell us only makes us want more. Discussing heavy shipping tobacco we learn that most of the cultivation, as one can well imagine, should be performed before the plants are set in the ground, and in order to do this the land, if a clayey loam, should be well and deeply broken in the autumn by a turning plough drawn by two or three horses or mules. The land should not be closely ploughed but left in ridges, the advantage of doing so being that a much larger surface is exposed to the weather. This particular advice referred to an area subject to frosts, but the soil in the Tropics equally benefits by being exposed. "If the depth of the furrow should be 8 in.," KILLEBREW goes on to say, "the ridge would probably be from 12 to 15 in. high, allowing a portion of the dirt to fall back in the furrow." In the States a second ploughing takes place, but then the furrows are only half as deep as with the first. Tobacco grown on uneven and hilly lands of course requires special culture and considerable skill, for the clean culture that tobacco requires is bound to make the land unproductive in the end. In Kentucky, when preparing the land for White Burley tobacco, two methods are employed, viz.: a plough with a "skimmer" just in front of the subsoiler to reverse a slice of the sod; whilst the other method is to turn the sod under with a two-horse plough to the depth of 8 in., and a revolving disc harrow is run over the land in April to cut the sod to pieces.

And so the tale goes on. "Tell me the soil that you have and I will tell you the tobacco that it will produce," the planting expert tells me, but they should, and probably do, add: "Tell me the soil that you have and the tobacco it will grow and I will tell you how to cultivate it and keep it up to concert pitch." In these notes, therefore, we cannot discuss the many ways

of cultivating the land according to the variety of crop to be grown, but plenty of ploughing, cultivating, and hoeing is necessary, as anyone who studies a book on tobacco culture can quickly realize.

In their pamphlet on "The Improvement of Tobacco Cultivation in Behar," MR and MRS. HOWARD tell us that "some form of furrow irrigation by which the plants can be watered without destroying the tilth is a great advantage when the rainfall has been insufficient. The main object of cultivation is to give the plant a loose soil into which the young rootlets can easily and quickly penetrate. If the tap-root is broken in transplanting, the plant tends to become surface rooted and develops a mass of fibrous roots. After the final preparation of the field (this is at Pusa) furrows about 18 in. wide and 4 in. deep are laid off at the proper distance, so that there will be a furrow between the alternate rows of tobacco, and these furrows, when irrigation is necessary, can be filled several times from a distributing channel which runs at right-angles to the rows." Drainage, the same as irrigation, must also be carefully arranged for, or else the land will become water-logged and stunt the growth of the plants whilst turning the leaves yellow. On this account, again quoting MR. and MRS. HOWARD, "the after-cultivation of the tobacco plant is of great importance, for unless the soil is frequently stirred the plants not only will not grow rapidly, but they also become yellow and unhealthy. After rain has fallen, if a surface crust has been formed, the ground should be stirred round the plants. As soon as the soil is thus given a new supply of air by this surface cultivation growth begins again and the plants take on, in a day or two, the dark green appearance characteristic of a thriving tobacco crop. This explains why it is important to pay so much attention to the cultivation of the soil with tobacco which, being a rapid grower, requires a large amount of air in the soil for the benefit of the roots;" for this reason also clean weeding is essential.—TROPICAL LIFE.

THE ORIGIN OF COAL.

The most recent investigations—those of JEFFREY (*Econ. Geol. IX.*, and also *Knowledge* October, 1915)—add considerably to our knowledge of the nature of coal. From these investigations, it appears that the more bituminous coals consist mainly of, and owe their properties to, spores of coal-measure plants. Improved methods of microscopic examination show that ordinary coal consists of alternate layers of shiny lignitoid material—woody remains—and of duller canneloid remains of flattened spores. It is wonderful indeed to reflect that the power developed in the steam-engine of to-day is derived from that stored in the minute spores of fern-like plants which grew ages ago. That these spores fell to the ground, were washed down in countless numbers by the rain, accumulated in lagoons, fell as a dust-like rain to the bottom, and underwent a sequence of slow changes, whereby they were transformed into coal. Undergoing yet further changes, and losing the last traces of organised structure, they doubtless yielded the mineral oils from which our stores of petrol are obtained,

SOILS AND MANURES.

THE SUPPLY OF NITRATES.

One of the minor misfortunes to the cause of the Allies, coming through no fault of their own, has been the landslide in the Panama Canal, which has interfered with the import of nitrate of soda from Chile by prolonging the time of the voyage. Nitrates are, of course, required in enormous quantities for explosives, but a very considerable amount of nitrate of soda—no less than 100,000 tons per annum—is used in agriculture for manurial purposes. No modern farmer would like to try to do without it; indeed, any increase in food production almost necessarily means an increase in nitrate consumption. Yet MR. ACKLAND recently stated in the House of Commons that the quantity now in this country, or on the way to it, was only about 30,000 tons.

As yet the situation is not serious. Farmers do not use nitrate of soda until spring-time; February or March would represent the earliest date when most people would apply it to their crops. Further, the Board of Agriculture has already made an arrangement whereby farmers can buy the sulphate of ammonia produced in this country, and formerly exported, at a price not much above the pre-war prices—£14 10*s*. per ton, instead of £12 10*s*. To this extent the situation is relieved, but, nevertheless, no one would care to see the supply of nitrate too much restricted.

There are two ways of dealing with the difficulty. One is to leave it alone, and trust that matters will somehow right themselves before February; the other is to arrange forthwith for a supply of artificial calcium nitrate. This substance was on the market as a fertiliser before the war; it has been tested on the large scale, and is known to give satisfactory field results; its defects have been studied, and a body of experience has been gained which would now prove very useful. But somehow it seems to have disappeared as a fertiliser since the war began. It ought not to prove impossible of manufacture, and in any case the situation ought not to be allowed to develop too seriously before steps are taken to cope with it.—NATURE.

THE COMPOSITION OF WOOD AND PLANT ASH.

R. A. BERRY.

In the autumn of last year, 1914, some ash analyses were made in the chemistry department of the West of Scotland Agricultural College. The object was to determine the amount of potash in the ash of certain forest and plant produce, with a view to the utilisation of the ash as a possible source of potash. Although several articles have since appeared in this JOURNAL* dealing with the same subject, the results obtained might still be of some interest.

* E. J. RUSSELL, JOUR. BD. AGRIC., Vol. xxi., No 8, November, 1914.
C T. GIMINGHAM, JOUR. BD. AGRIC., Vol. xxii., No. 2, May, 1915.
E. J. RUSSELL, JOUR. BD. AGRIC., Vol. xxii., No. 5, August, 1915.

The ashes, which were obtained by arrangement with the Forestry Department of the College, may be taken as being fairly representative, and they were produced and collected under conditions in operations in practice.

The percentage of potash soluble in (a) strong hydrochloric acid and in (b) water were determined; the results are given in the following table:—

Ash.	Potash (K_2O) percentage soluble in		Percentage of "Total Potash"* soluble in water.
	Acid	Water.	
Bracken	20·45	10·61	51·9
Spruce	11·94	8·23	68·9
Mixed forest produce	3·13	1·50	47·9
Hardwood, engine fire	10·44	6·77	64·8
Softwood, forest fire	11·79	6·53	55·4
Hardwood, largely oak trimmings ...	3·53	2·75	77·9
Flue dust from blast furnaces:			
No. 1	3·75	2·13	56·8
No. 2	3·93	2·64	67·2

Considered from the point of view of the total potash content, it is clear that four of the ashes could quite well be used as a potash manure in place of a low grade potash salt such as kainit, which contains 12·4 per cent. of potash. Indeed, on a valuation of the bracken ash on the basis of the potash soluble in strong acid, and taking the price per unit of potash previous to the war at 4s., the value of this ash would work out at about £4 per ton, whilst several of the other ashes would be worth about one half of this figure. Valued according to the current market price per unit of potash the price per ton would be considerably higher.

On the other hand, not much more than one half of the total potash is soluble in water, the soluble potash salt being mostly the carbonate of potash, so that it would appear questionable to value the ashes for manurial purposes on the basis of the total potash content only, whilst a valuation based upon the water soluble potash might give a low estimate of their true value.

Some of the ashes contain appreciable quantities of phosphates, which must be taken into account in judging the ashes for manurial purposes. The percentages of phosphates and other constituents are given in the following table:—

Ash	Phosphoric acid expressed as		Lime CaO	Magnesia MgO	Manganese oxide MnO
	P_2O_5	$Ca_3(PO_4)_2$			
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Bracken	3·37	7·35	10·90	3·69	0·84
Spruce	7·01	15·30	28·20	2·90	1·35
Mixed forest produce ...	1·54	3·36	12·40	2·03	0·47
Hardwood, engine fire ...	5·02	10·95	44·70	4·71	2·23
Softwood, forest fire ...	5·23	11·41	25·20	3·80	2·14

* Total Potash=Potash soluble in strong hydrochloric acid.

The phosphates present are practically all insoluble in water and are mostly in the form of calcium and magnesium phosphates. Their value for manurial purposes should be much the same as the value of the phosphates in steamed bone flour. Their presence in such relatively large amounts adds, of course, considerably to the value of the ash. The other constituents given in the table are, perhaps, of small interest only.

When the material is properly burnt, the ashes are bulky and of a light friable and powdery nature, generally grey in colour. If necessary they should be passed through a sieve of 3/16-in. mesh, to get rid of stones and unburnt material. They must be protected from rain, otherwise the soluble potash salts might all be dissolved out and lost. They are strongly alkaline and, when mixed with ammonia salts, liberate the ammonia freely, more especially if the ashes are damp; otherwise, with the exception of ammonia salts, ashes form a suitable medium for mixing with most manures. They must be stored in a dry place.

As the value of the ashes is judged by the amount of potash and phosphates which they contain, the following table may be useful for the purpose of comparison :—

Ash.	Total potash K_2O	Percentage of total potash soluble in water.	Phosphate of lime $Ca_3(PO_4)_2$
	Per cent.	Per cent.	Per cent.
Bracken	20·45	51·9	7·35
Spruce	11·94	68·9	15·30
Mixed forest produce	3·13	47·9	3·36
Hardwood, engine fire	10·44	64·8	10·95
Softwood, forest fire	11·79	55·4	11·41
Hardwood, largely oak trimmings ...	3·53	77·9	2·40
Flue dust from blast furnaces:			
No. 1	3·75	56·8	Not ascertained
No. 2	3·93	67·2	

Apart from the chemical content, the economic importance of the ashes at the present time will depend upon the quantities available. The results of some recent investigations* given below will throw some light on this point.

1. From the "lop and top," undergrowth, weed growth, and litter in any average type of woodland, about ½ ton of ash is produced per acre.

2. From portable saw mills and foreign timber mills, where wood constitutes the fuel, about ¼ cwt. of ash per day is obtained as a by-product.

3. Ten acres of fully-stocked bracken land is found to produce 1 ton of ash, the quantity being dependent upon the density of the crop.—JOURNAL OF THE BOARD OF AGRICULTURE.

* See Leaflet No. 25, Board of Agriculture for Scotland.

FIXATION OF NITROGEN FROM THE ATMOSPHERE.

The most recent research on the subject, that of Dr. E. Mameli and Professor G. Pollacci, shows that not only the Leguminosæ, but many other flowering plants are able to make use of atmospheric nitrogen. Among flowering plants for which they claim this power are Cucurbita pepo, Acer negundo, Polygonum fagopyrum, and they also ascribe it to such "Water-Ferns" as Azolla caroliniana and Salvinia natants. Frank long ago maintained the view that the power of assimilation of free nitrogen belongs to all green plants, and this view receives support from these recent researches.—Gardeners' Chronicle.

ORGANIC MATTER AS A CULTURE MEDIUM FOR AZOTOBACTER.

F. L. MOCKERIDGE.

In order to discover how far *Azotobacter* is capable of utilizing the wide range of organic compounds which occur in soil, cultures of the organism were inoculated into series of media made up of various organic substances and mineral salts. The organic substances in question included humates, polysaccharides, sugars, alcohols, the calcium salts of organic acids, esters, glucosides and benzine derivatives.

In the case of the humates, growth was only obtained when the organic matter was supplied as ammonium humate and no nitrogen was fixed. The availability of the glucosides was restricted somewhat by the products of their decomposition and the benzine derivatives proved totally unable to provide a source of energy for *Azotobacter*. The presence of either of these two latter classes of compounds, however, never inhibited growth on manitol-agar plates. The carbohydrates tested showed themselves in general to be readily available sources of food for *Azotobacter*. The returns of nitrogen fixed for the expenditure of food material varied considerably and the rule seemed to be that the longer the time taken to use completely a unit mass of the nutrient, the less nitrogen was fixed upon that medium.

Considering the wide range of compounds which *Azotobacter* proved itself capable of assimilating, it is evident that any ordinary soil must contain abundant food material for the growth of the organism.—Bull. Int. Inst. of Agriculture.

FOREST SOILS AND NITROGEN.

The usual practice is to classify soils crudely according to their chemical and physical composition, but we can often get a better idea of their constitution and requirements by considering them in relation to the kind of crops they bear. In the tropics this is particularly so where a wide range of soils occurs between the two extremes of desert and dense forest. Speaking generally, it is not the soil particles so much as the heat and the rainfall as well as the aspect, including physical conformations, that determine the most

important features of a soil's fertility, because these factors decide what plants can grow there. If the rainfall is heavy, the natural covering will be forest, and as a result of vegetable decay the underlying soil will be rich in humus, and will exhibit certain well-marked bacterial characteristics. This soil is the natural medium of growth for such trees as cacao and rubber, and becomes ultimately what we have come to call an orchard soil. On the other hand, soils which are more exposed to wind and sun, and which receive a lighter rainfall, are inhabited naturally by a hardier type of vegetation, and these are the soils which are ultimately brought under the plough. Such soils as these frequently exhibit greater alkalinity and greater extremes of texture between 'heaviness' and 'lightness', and in the matter of colour, than orchard soils, while the bacterial activity is also different in many respects.

It is our present object to consider what takes place in an orchard soil that makes it different from an arable soil, especially in respect of nitrogen supply.

The form in which cacao and other orchard crops obtain their nitrogen from the soil has been the subject of speculation for some time. Knowing that the supplies of free mineral bases, such as lime, are deficient in such soils, it has been suggested that ammonia formed in the process of ammonification may function as a base for the neutralization of nitric acid formed during the later stages of nitrification. It is well to bear in mind, however, that nitrification may not be active in all orchard soils and that, moreover, nitrifying organisms will not tolerate free ammonia. Where nitric acid is absent it may be supposed that the ammonia would combine with other acid radicles like carbon dioxide or some organic acids, the nitrogen in this way finding an entrance into the roots of plants in a less concentrated form than ammonium nitrate.

In an examination of cacao soils in Dominica it was found that at the end of several years' trials, the amount of nitrogen was greater than at the outset, and this is attributed to nitrification. A bacterial test of the different soils clearly demonstrated the existence of nitrogen fixing organisms, and it has been concluded that under the conditions of the plot experiments referred to, considerable accretions of nitrogen may occur as the result of the action of free nitrogen-fixing bacteria of the Azotobacter type, and that the amount of nitrogen fixed may be very greatly increased in the presence of an ample supply of organic matter.

These conclusions are very important because nitrogen fixation is not supposed to play an active part in such soils, at any rate under temperate conditions. An interesting note has appeared on nitrogen fixation in Danish forest soils. *Azotobacter chroococcum* is only occasionally present in these soils, but in some localities where there is much calcium carbonate, two other species of Azotobacter were found present. The causes of the absence of the principal species from forest soils were thought to be due to lack of calcium carbonate, to too low a temperature, and to an excess of humic matter.

That temperature is an important factor has been shown recently in India, and it may explain the apparent divergence between the cases of Azotobacter and the orchard and forest soils of Dominica and Denmark. In general, 30°C was found to be the optimum temperature for maximum activity in India, and it would appear therefore that warmth is an important factor.

In the Dominica investigations the temperature of the plots was studied, and the observations never showed a reading higher than 25°C.

It has to be remembered that though they have many features in common, the conditions of an orchard soil and a forest soil are not absolutely parallel. So far no bacterial examination of true forest soils has been made in the West Indies, and we do not know whether Azotobacter occurs in them or not. If these nitrogen-fixing organisms are absent, it would be interesting to know how the supply of nitrogen is maintained. The suggestion arises as to whether mycorhiza may not play an important part. The fungi of mycorhiza live either on or in the roots of plants growing in humus soils, and are very widely distributed. The relation between the fungus and root is generally symbiotic, that is to say, useful to both organisms, at least in the case of those which live within the root, the fungus assisting in the collection of nitrogen and in the elaboration of albuminoid substances in return for carbohydrates manufactured by the green plant There are instances where the union occurs between a fungus and a non-chlorophyllous plant, as in the case of Neottia. Here we apparently have an example of a higher plant parasitic on a fungus, and it is difficult to see what advantage is derived by the fungus. In general it is more than likely that fungi of mycorhiza are of greatest value to the higher plants on account of their capacity for manufacturing higher nitrogenous compounds from soluble humus which they absorb from the soil. It should be pointed out, as an interesting morphological feature of the roots of trees bearing the external fungi, that root hairs are entirely absent, a circumstance which shows that the fungus functions as an organ of absorption.

The extent to which mycorhiza plays an active part in the nutrition of tropical forest plants is not definitely known, and it would be interesting if this question were given specific attention in the West Indies. Further, it may be the subject of enquiry whether many of our economic plants like rubber and cacao can, under certain soil conditions, make use of mycorhiza, especially where the soil is typically acid.

It would appear desirable for the planter to realize that the presence of lime, the importance of which in the soil has been so strongly emphasized, does not seem always necessary for orchard or forest fertility. Acidity does not appear injurious, and may even be beneficial, as is thought to be the case with rubber in the Federated Malay States. Of course with arable soils, effects other than neutralization have to be considered. Here lime is important because of its physical as well as its chemical properties rendering the soil more amenable to cultivation. In the case of tropical soils we know that the addition of lime both increases nitrification and nitrogen fixation. Recently in the Philippines it has been demonstrated that the former process is increased by more than half by the application of 6 tons of lime to the acre, while all observers have called attention to the importance of lime the latter process. The fact remains that orchard and forest plants, and even arable plants, can, in some circumstances, thrive in the absence of lime, and it would be interesting to know exactly to what extent bacteria are responsible for their supply of nitrogen.—Agricultural News.

RESEARCHES ON THE ABSORPTION OF AMMONIA BY THE SOIL.

After a critical discussion of the different theories regarding the absorption of gases and liquids, the writer gives an account of his own experiments for the purpose of determining the absorptive capacity of different soils. Research hitherto has dealt exclusively with the various constituents of the soil and the results are of no general value to practical agriculture.

As a substance capable of absorption the writer used ammonia gas which has the treble advantage of being easily absorbed, of existing in the air, and of constituting a source of nitrogen for the soil. The absorption of the gas was determined by two different methods, various samples of soil being taken, some from Germany, some from other countries. The capacity of the soil for retaining hygroscopic moisture was estimated by the method of MITSCHERLICH.

The experiments have shown that the absorption values do not allow of any better conclusions being drawn, for practical agriculture than those obtained from physical and chemical analyses of the soil. In German soils the absorption value was parallel to the hygroscopic value. In the case of "red soil" (1) *terra rossa*, the hygroscopic capacity was more regular than in German soils. This is probably due to the fact that the hygroscopic capacity of the *terra rossa* is not always comparable with that of the German soils.

The isotherms constructed on the values of absorption of ammonia gas by the soil closely resemble those constructed on the absorption values of the same gas by charcoal. The greater part of the gas was absorbed in a few minutes, but a stationary condition was only reached at the end of some hours. In the case of soil still containing hygroscopic water, the absorption value was much higher than in that of dry soil, but did not reach the sum of the aborption values for dry soil and water. Part of the ammonia gas absorbed was strongly retained by the soil, even if the latter were subsequently exposed for several weeks to the open air. It was impossible to obtain any parallelism between the absorption of an ammoniacal solution and that of ammonia gas, although, according to the writer some relation does exist between them.

The charcoal from lime trees has a great capacity for absorbing ammonia gas, but possesses less power of absorbing this gas when dissolved in water.

The writer concludes from his experiments that the absorption of ammonia gas varies considerably on account of the complex nature of the soil. It is therefore very difficult to formulate an absorption theory applicable to all kinds of soil. However, it seems that the theory of FREUNDLICH according to which absorption is a condensation process occurring at the surface of the soil particles, is the most probable.—BULL. INT. INST. OF AGRIC.

(1) The "Roterde" or term *terra rossa*, came in some cases from Istria, in others from Brazil, East Africa, etc.

TOP-DRESSING.

The top-dressing of wheat in winter with a nitrogenous manure is not a common proceeding, and therefore the leaflet issued by the Board of Agriculture, suggesting an application this month of sulphate of ammonia, has created some little surprise. It should be noted that the counsel based on the result of Rothamsted experiments and that the advice is sufficiently qualified to warrant the assumption that the writer was aware of the pitfalls associated with such a proceeding. The wheat crop is one of the least exacting in its wants, but it is exceedingly responsive to timely attention in what may seem small matters. It is especially sensitive to judicious winter and spring management, a peculiarity that makes farmers chary about using forcing manures at this time of year. To the inexperienced a strong winter growth might appear to be the main thing to aim at: in practice, however, excessive winter luxuriance is scrupulously to be avoided. As many growers have greater difficulty in moderating growth in an average winter than in inducing it the diffidence about using a quick-acting fertilizer will be understood. It is not asserted that sulphate of ammonia should never be given in December; but it is claimed that cases in which the practice can be adopted with good results are few, and that great care is needed to select those where it would be profitable.

TILLERING PROCESS.

The objection to excessive winter development is well-founded and the reason is simple. The tillering or stooling faculty of this and other cereals plays a very important part in determining production. The skilful grower endeavours to utilize this habit of growth to the fullest extent. Some might even go so far as to say that his success depends upon the way he contrives to foster it. Any way, it is an accepted fact, that a plant that tillers badly will never yield a heavy return of grain or straw. The tillering process takes place in late spring or early summer. The weather influences its activity, but the development of the plant is also of importance. A crop that is too forward in growth does not branch out so freely as one moderately advanced, and hence the concern with which the farmer regards wheat that has become "winter proud." So serious a view does he take of undue luxuriance in winter that in spite of the risk he runs he will delay drilling until November, when he might have got the seed in in good condition early in October, and if other devices fail he will run his sheep over it in early spring to eat it down to the desired state. The vital point is to keep the plant moving steadily in winter and to topdress at a time that will make the spurt synchronize with the stooling operation. If this course be pursued the crop will be thick on the ground, as well as long in straw and ear, and the prospect of a prolific yield greatly improved as compared with what would result from winter luxuriance that would restrict the spreading habit in spring.

A nitrogenous manure to be effective must be given at the right time. The observant husbandman has little difficulty in fixing upon the correct moment. He watches the progress of the plant and when it appears to be in trouble he gives the needed stimulus. Sulphate of ammonia is not quite so rapid in its action as its imported rival, and therefore can be applied a little earlier, but few care to risk topdressing wheat with this manure before the second half of March, when, if the crop shows signs of flagging, 1 cwt. to the acre is extremely helpful.—THE TIMES.

MANURING EXPERIMENTS WITH CITRUS SEEDLINGS.

B. F. FLOYD.

In order to obtain more accurate information on the value of various manures for citrus trees, pot culture experiments were carried out with pomelo seedlings grown in sand. Measurements of the length and breadth of the stem and length and breadth of the leaves were made during the season.

This preliminary report deals with the effect of ammonia and phosphoric acid from varying sources. The best growth was obtained with a combination of dried blood and acid phosphate. The addition of lime appeared to retard growth. Sulphate of ammonia and acid phosphate gave the poorest growth of any of the various combinations and showed an improvement when lime was added.

Basic slag was a better source of phosphate than superphosphate for use with ammonium sulphate and nitrate of potash but only second best with dried blood. Nitrate of soda and nitrate of potash were equal in their effects of growth.—BULL. INT. INST. OF AGRIC.

RAIN MAKING.

The artificial production of rain is to be put to the test of practice in Australia. According to THE ELECTRICIAN the New South Wales Government will finance the experiments, which will be carried out by Mr. J. G. BALSILLIE, who for years has been conducting research in this connection and who has patented his device. It is based on the following lines. In the laboratory he finds that if a room be filled with steam, the discharge of high tension direct current electricity together with the simultaneous discharge from a powerful Röntgen ray tube causes the whole of the air to be cleared of steam in $1\frac{1}{2}$ seconds, the floor of the room being covered with large drops.

A captive balloon coated with metallic paint at a height of 6,000 to 7,000 feet will be used to discharge electricity into the atmosphere and this it is hoped will cause sufficient ionisation to provide nuclei upon which the moisture of the clouds may condense. Mr. BALSILLIE believes that a number of these stations would draw all the moisture from the clouds and would also cause the cessation of natural thunderstorms.—BULL. INT. INST. OF AGRIC.

ENTOMOLOGY.

THE CONTROL OF INSECT PESTS.

P. B. RICHARDS.

Fumigation by carbon-bisulphide is accomplished by injecting into or pouring round the objects requiring treatment the requisite quantity of liquid carbon-bisulphide.

Properties.—Carbon-bisulphide is an oily colourless liquid which possesses a pleasant smell when pure, but the commercial product usually smells like rotten eggs and is yellow on account of contained impurities. It is very volatile, vapourising with extreme rapidity in the open at ordinary temperatures. It should be stored in stoppered casks or jars—not corked bottles—and to prevent loss by evaporation a small quantity of water may be run in. As the liquid is heavier than water and is only very slightly soluble, the water forms a protective layer over the top of the carbon-bisulphide.

As a liquid it is highly inflammable, while the vapour when mixed with air explodes violently on ignition. The ignition point is very low. No fire of any sort, or even any hot body the temperature of which is above the boiling point of water, 212°F., should therefore be allowed in or near a store of carbon-bisulphide or the place where fumigation is in progress. In treating a building supplied with electricity, the current should be cut off before fumigation commences. Carbon-bisulphide should be stored in a cool place, and should not be exposed to the sun.

Liquid carbon-bisulphide in considerable quantity is poisonous to man. Inhalation of the gas produces violent headache and nausea and is to be avoided, but is not dangerous in the same degree as hydrocyanic acid gas. The main danger in its use is from fire.

Insects subjected to the action of carbon-bisulphide vapour are at first anæsthetised and later asphyxiated. The action is slow, taking many hours to ensure death unless the atmosphere is very heavily charged with the vapour.

Carbon-bisulphide vapour is readily diffused, getting thoroughly into all holes and crevices. It is therefore, notwithstanding its lower toxicity, a better fumigant than hydrocyanic acid gas for treating seed, cereals, pulses. and other foodstuffs, and close packed manufactured articles. The vapour is heavier than air, so should be applied from above downwards.

Uses.—(a) Seeds and foodstuffs stored for any length of time, especially in hot climates, are very susceptible to insect attack, which may be so serious as to render the stock valueless either for food or for planting. To mention a few which occur in Malaya, stored rice is attacked by Rice Weevil, *Calandra oryzæ*, and by the caterpillars of a small grey Tineid moth, *Sitotroga cerealella*. Wheat, flour, grain, and similar foodstuffs are often heavily infested with small Pyralid moths of the genus *Ephestia*, the caterpillars of which may be found in matted galleries of silk running throughout the food. Flour and biscuits also are attacked by a small red Tenebrionid beetle, *Tribolium sp.*,

which spoils provisions by giving them a very repulsive taste. Dried peas and beans are attacked by several species of Bruchid beetles, sometimes to the total destruction of the stock. Annoyance is often caused to smokers by the cheroot beetle, *Lasioderma serricorne*, which infests stored tobacco, the larvæ feeding here and there throughout the body of the cheroot, and the adult making small round holes in the wrapper for emergence. The loss to the tobacco manufacturer from the beetles boring through bales of cigar wrappers of good quality, thus rendering them unfit for use, is often enormous.

These are but a few cases which might be cited of insect attack upon stored vegetable matter. Owing to the smallness of the stocks in any one place these pests have not compelled the attention here which has had to be given them in the larger grain producing countries, where enormous stores of grain are held for considerable periods. Nevertheless, the average loss in Malaya must reach a considerable sum. It is estimated that in India the Rice Weevil alone "at a moderate estimate may be said to destroy five per cent. of all stored grain which is kept for more than a couple of months after harvest." The methods applied on a large scale for big stocks of grain elsewhere are equally applicable for warehouses, kedais, and private stocks here, and if practised would amply repay the outlay in labour and materials.

There is no known method for treating stored vegetable produce in general which renders it permanently immune to insect attack if exposed, and which does not at the same time unfit it for food or for germination. The only sure preventive is to store in insect proof bins, jars, or tins after getting rid of any infection. It is to get rid of the insects harboured at the moment that fumigation with carbon-bisulphide is employed. Re-infection may take place quickly if the fumigated material is not at once stored in an insect-proof place. Should this not be feasible, repeated fumigations may be necessary in order to prevent the pests from reaching enormously destructive proportions.

For the treatment of grain one pound of carbon-bisulphide is allowed to each hundred bushels. In treating large quantities, some of the liquid is introduced through a pipe into the middle of the heap and the remainder poured on top. To keep the pipe clear when pushing it into the heap, a stick is loosely fitted into the pipe and withdrawn leaving the pipe in position. For smaller quantities, the material to be treated is placed in a barrel or bin that can be made fairly airtight—the less leakage, of course, the better—and the requisite quantity of carbon-bisulphide either placed in shallow dishes on the top of the material or, if grain, poured directly on to the material. The cover is at once put on, and left for twenty-four hours, after which the bin is opened and allowed to air, and the material after airing at once stored in insect proof receptacles. If storing is delayed for a day re-infection may have taken place.

The quantity of carbon-bisulphide required for fumigating small quantities of material may be taken as one ounce to fifty gantangs if the chamber is full of grain, or the same quantity to fifteen cubic feet of space if other materials are being treated. For small vessels or boxes, allow one teaspoonful to each cubic foot of space.

A useful form of fumigating chamber consists of an airtight wooden box the cover of which is provided with a flange which fits into a gutter all round the outside of the box. The gutter is filled with water, and when the lid is put on the flange dips into the water, making an airtight fitting. This type of chamber is not available for hydrocyanic acid gas fumigation as this gas is soluble in water.

In the absence of an airtight box, heavy cloths thrown over the top assist in retaining the fumes.

Soil Fumigation.—Many injurious animals such as cockchafer grubs, wireworms, root aphids and eelworms, living below the surface of the ground and feeding upon the roots of plants, are controlled by injecting carbon-bisulphide into the soil close to the affected plant. Care should be taken not to allow the fluid carbon-bisulphide to come into contact with the roots, or the plant may be badly injured. No trouble should however arise from contact of the roots with carbon-bisulphide vapour, except perhaps a temporary set-back which is more than compensated for by the subsequent increase in vigour of the plant.

Carbon-bisulphide is best injected into the soil by means of a special injecting pump which regulates the dose and the depth at which it is applied. In the absence of such apparatus, a hole to the required depth may be made with a rod, the dose of liquid poured in, and the hole at once stopped with earth.

The individual doses vary from a quarter of an ounce to four ounces, and the depth at which applied may be from six to twenty-four inches according to the nature of the soil and the conditions of attack. No fixed rules can be laid down to meet all cases, and planters who contemplate using carbon-bisulphide for soil injection are recommended first to communicate with the Agricultural Department.

Treatment of large boring beetles in fruit trees, rubber trees, etc.—Clean up the mouth of the burrow with a sharp knife, or with a small auger. Inject about a teaspoonful of carbon-bisulphide into the hole and plug up the hole with a tight fitting cork or with clay. An ordinary oiling can makes an effective injector.*

SULPHUR DIOXIDE.

Sulphur dioxide is prepared by burning sulphur in air. For purposes of fumigation the sulphur is placed in a shallow open vessel which in turn, as a precaution against fire, is placed in a larger vessel containing sand and earth. Two pounds of sulphur are buried for each thousand cubic feet of air space.

Properties.—Sulphur dioxide is a colourless gas, with a characteristic suffocating smell which produces a sensation of choking. It is not inflammable. The gas is soluble in water in combination with which it pours sulphurous acid.

Sulphur dioxide gas is poisonous to insects but it is also directly harmful to vegetation. Leaves are "scorched" by a weak mixture of the gas in air, while at greater strengths buds and young shoots are killed. The fumes also destroy the germinating power of seeds and have considerable bleaching effect on fabrics.

Use.—It is obvious from a consideration of the above properties that sulphur dioxide is not applicable to plant fumigation. Its major use is for killing bedbugs and such like vermin in empty rooms and for this purpose it is excellent, being cheap, effective, and easy to employ. The sulphur is ignited and the room at once closed. The fumes should be allowed to act for 24 hours.

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* BAINBRIGGE FLETCHER recommends for boring beetles the injection of a mixture of two parts chloroform and one part creosote. This mixture has the advantage over carbon bisulphide of acting as a preservative to the wood.

On the other hand it is more expensive. See "Some South Indian Insects." p. 133.

CARBON DIOXIDE.

Carbon dioxide can be readily prepared by treating limestone or marble with hydrocyanic acid. The gas is, however, universally used for the preparation of mineral waters for which purpose it is put up in liquid form in steel bottles, and it would probably be more convenient to obtain these than to prepare the gas on a small scale for oneself.

Properties.—Carbon dioxide is a heavy colourless gas, which is incapable of supporting combustion or respiration. Asphyxiation results from breathing the pure gas, while an atmosphere containing upwards of 10 per cent. of carbon dioxide produces an effect on animals similar to narcotic poisoning. Plants and particularly seeds are able to withstand for a considerable period an excess of carbon dioxide which is quickly fatal to insects. Sufficient work has not yet been done on the subject to warrant any broad generalisations, but there can be no doubt of the utility of the gas in the treatment of delicate plants and in the disinfection and storing of valuable seed. It is, however, in connection with valuable dried products such as spices and tobacco that carbon dioxide is likeliest to appeal to Eastern cultivators. Hydrocyanic acid gas and carbon bisulphide cannot be unreservedly recommended for the fumigation of such products on account of the danger of impairing their quality. No such result will be feared if carbon dioxide is used, provided that the material for treatment is dry. In particular should this method be applied to all cigars, cigar wrappers, cigarettes and other valuable tobacco before storing and again before packing as a precaution against the attack of the cheroot beetle.

NICOTINE TOBACCO.

Fumigation with tobacco is only of service in the treatment of plant lice and such small insects attacking greenhouse plants and small pot plants. The fumes are obtained by burning tobacco stems and dust, or by evaporating aqueous solutions of nicotine in a shallow pine. The plants to be fumigated may be placed in a fairly airtight box and the fumes led in from the generator through the bottom of the box by means of a pipe.

SUN DRYING.

One should apologize for the inclusion of such a foreign subject in a chapter on Fumigants, but as the treatment of stored grain is one of the most important matters considered under that heading this is perhaps the best moment to discuss the use of the sun as an insecticide.

All insects require a certain amount of moisture in their surroundings and their food to enable them to live. This percentage varies according to the habit of the insect. Less is required by grain feeding insects than by most others, but even they cannot live in thoroughly dried grain. The object of sun drying is to reduce the moisture content of the attacked food beyond the minimum necessary to support the life of the particular pest.

Calandra oryzæ, the rice weevil, which yearly destroys large quantities of stored rice in Malaya is one of the pests which is amenable to this method of treatment. BAINBRIGGE FLETCHER, writing of this pest in India, says:—" It has been found by experiment that a certain minimum (about 8 per cent.) of moisture in their surroundings is necessary to the successful existence and breeding of these weevils, so that if grain can be well dried in the sun to reduce its moisture content as much as possible and then stored in insect

proof receptacles in a dry place it will be as secure from attack as is possible under practical conditions. In districts where paddy is stored in jars there should be little difficulty in having the grain sun dried before storage and then fastening up the jars so as to exclude weevils; for jars, not in use, an earthenware cap, luted on with clay, might be used, and those in daily use could be covered simply with a fine cloth tied round the neck of the jar. Care should of course be taken that the jars are thoroughly cleaned out and free from weevil or old infected grain before killing them afresh, and also that all fastenings are sufficiently tight to be weevil proof."

Sitotroga cerealella, a small moth which is another important pest of stored rice, the pulse beetles which destroy stored peas and beans, and other small insects of similar habit, may be kept in check by sun drying. It is *par excellence* the method for kedai-keepers and raoits who have comparatively small quantities of such material to handle. Any dry place will serve to spread out the grain, but flat adobe or cement roofs would be ideal. Large stocks, however, cannot be conveniently handled, and when such require treatment, carbon bisulphide should be employed.—F. M. S. AGRICULTURAL BULLETIN.

MARKET FOR TEA.

After a long period of depression, the market for tea has at length touched a level that suggests that it has found its basis. At the top point reached in the summer common kinds stood at $11\frac{1}{2}d.$ to $11\frac{3}{4}d.$ per lb., and very little was to be got under. At such prices demand was very keen, because there was so little to go round; now the reverse is the case, there being an abundance, while trade is marked by decided languor. Common of useful quality can be bought at *7d.* to $7\frac{1}{4}d$, while inferior is to be had in plenty at *6d.* to $6\frac{1}{2}d.$ When abnormally high prices ruled there was every inducement for planters to pluck freely. This has been the case, and quality has consequently been sacrificed to quantity. The market is overdone with a heavy weight of Indian tea of inferior and plain description, and has caused general reluctance on the part of buyers to operate. More recently there has been more enquiry, prices being very moderate; also there is the usual stocking going on in connection with the Christmas trade. The increase in the duty has told upon consumption and hit the distributor, as more capital is locked up by the extra duty, thus leading to a certain stringency in the financial position. Deliveries from the docks are very slow owing to the shortage of labour, and this matter promises to get worse instead of better. Merchants at the lower prices have been more disposed to offer rather reduced quantities recently of Indian. There is a big yield in India this season, the outturn for November being particularly heavy. This has also had an adverse effect upon the market, but the ratio of progress between actual crop and export figures is widely divergent, because shipments from Northern India have been much retarded owing to the scarcity of tonnage, and this shortage is likely to become accentuated. As the outcome of this state of affairs, it is apparent that the selling of Indian tea will be more than usually prolonged.—LONDON COMMERCIAL RECORD.

DRUGS.

THE CULTIVATION OF CINCHONA IN JAVA.

DR. J. VAN BREDA DE HAAN.

During the period from 1829 to 1837, attention was frequently drawn to the probability of a future shortage of cinchona bark from South America, where the tree occurs wild. Several botanists who were acquainted with the climatic conditions of Java suggested that the Dutch Government should take steps to introduce the cinchona into the island. In 1851 the first serious attempt at transporting the tree was made: Weddel had succeeded in collecting some seeds of *Cinchona calisaya* in Bolivia; some of them had reached Paris and plants had been raised from them in the hot-houses of the Jardin des Plantes. The Botanical Gardens of Leyden obtained possession of one of these cinchonas in exchange for some other tropical specimens, and this was sent to Java in 1851; it arrived there in a deplorable condition, but fortunately two cuttings made by Teysmann took root and one of them was the origin of a tree which grew satisfactorily for 16 years.

But these first attempts were not considered sufficient, and in 1852 the Government sent Dr. Hasskarl to South America to collect seeds and live plants of the best species of the genus and bring them to Java. He got some thousands of seeds and about 60 plants; owing to some mischance, the latter were lost, but the seeds reached Holland in good condition. After despatching other consignments of seeds, Hasskarl succeeded in embarking in August 1854, with 21 cases of live plants and a large quantity of seeds, on a Dutch man-of-war which was sent to Callao to meet him. In the middle of December, he arrived in Java with his precious cargo; 75 plants out of the 500 had survived the difficulties of transport; these were planted at an altitude of 5,000 feet at Tjibodas, where the two cuttings of *Cinchona calisaya* from Paris were already established. All the cinchona trees now cultivated in Java under the name *Cinchona calisaya javanica* are descended from these cuttings. Through the Dutch consul at La Paz in Bolivia were obtained the seeds from which have been raised the specimens of *Cinchona calisaya* Schuhkraft grown in Java.

What, however, contributed more than all these introductions to the development of cinchona cultivation in Java was the purchase of a number of seeds sent from London in 1865 by George Ledger. The latter had obtained the seeds from his brother, Charles, who was travelling in Peru and Bolivia in order to buy cinchona bark. From these seeds collected by Charles Ledger were raised about 20,000 plants, which subsequently produced bark superior in quality to that of all the others.

Further introductions, in the succeeding years, gave rise to a quantity of other cinchonas of different varieties and species; of these some twenty are cultivated in Java, but often the external differences between them are so small that it is necessary to determine them by chemical analysis of the bark.

The most common species and varieties in Java at the present time are *Cinchona ledgeriana*, a variety of *Cinchona calisaya*, and a hybrid, *C. ledgeriana* x *C. succirubra* : these produce nearly all the bark used for making salts of quinine.

For the production of bark used for pharmaceutical preparations and cinchona wines, *C. succirubra* and *C. robusta* (which is a hybrid between *C. officinalis* and *C. succirubra*) are grown. *C. robusta* is less rich in quinine, but contains in its bark a larger amount of tannin than the other varieties of hybrids, and at the same time produces other alkaloids, such as cinchonidine, quinidine and cinchonine.

The efforts of the Dutch Government have not been limited to merely introducing cinchona seeds into Java, but have also extended to the improvement and spread of cinchona-growing by demonstrations and trials carried out in the Government plantations established for the purpose. By means of botanical and chemical studies pursued for the most part in the laboratories devoted to this work and situated in the centre of the Government plantations, precise information has been obtained on the distribution of the various alkaloids in the different species of *Cinchona* suitable for cultivation in Java. It is found that for quinine production *C. ledgeriana* should be preferred while the barks of *C. succirubra* and *C. robusta* contain larger amounts of cinchonidine. Some alkaloids of less importance, such as quinidine, are especially found in the bark of *C. calisaya javanica ; C. micrantha* contains chiefly cinchonidine.

The alkaloids occur in the bark of the trunk, branches and roots. In the leaves and flowers a very small amount of cinchonine is found. The exterior part of the cortex is always the richest.

At two years of age, a cinchona tree attains its maximum quinine content; afterwards the amount of alkaloid decreases a little, until the tree is 12 years old. After this age, there is scarcely any change. As the bark of a five-year-old tree is of small dimensions, the maximum production per tree is only attained after the age of 12.

The quinine content of the Bolivian cinchona introduced by HASSKARL is estimated at about 2 per cent. The first tree obtained from these seeds only produced 4 per cent. after six years' growth. By continued care and with increasing knowledge of the improvements possible, a bark with 11 per cent. of quinine has been obtained, and the average quinine content for the last few years for all Java was about 6 per cent. (in 1913, 6·12 per cent.)

This improvement is the result of continued selection and the care taken in improving the plantations by using for seed, cuttings or grafting, trees whose alkaloid content had been ascertained by analyses. This method was carried out very conscientiously, especially in the State plantations, while the improvement of private plantations was assisted by the propagation of the best varieties and the sale of these improved cinchonas.

CULTIVATION.

The land most suited to cinchona-growing in Java is between 1,250 and 2,000 m. (4,000 and 6,500 ft.) above sea level. *C. robusta* grows well at the latter height, but a greater altitude would expose the plantations to damage from night frosts. Volcanic soils of recent origin give the best results, provided they are damp enough. Periodic drought hinders vigorous development,

The soils in the south-west of Preanger, near Bandong, are the only ones presenting the necessary conditions for satisfactory cinchona cultivation. Frequently plantations have been tried elsewhere, but the results have almost always been mediocre and unremunerative. In the other parts of Java and Sumatra there are only small and unimportant plantations.

As soils really suitable to cinchona growing are only to be found in the mountainous parts of Java, the exploitation of a plantation offers peculiar difficulties.

In establishing a plantation, choice should by preference be made of well wooded land on a slight slope, gving on clearing a soil rich in organic matter of good quality and permitting of adequate drainage. After the trees are felled, the ground is divided into terraces, these being well levelled to prevent washing away of the rich humus soil.

The cinchona seeds are sown in special nurseries well sheltered from the sun, which the germinating seedlings cannot bear. The seeds are extremely small; one pound of *C. succirubra* seed contains about 4 million, and a pound of the seed of *C. ledgeriana* about 1½ million. The greatest precaution is necessary to maintain sufficient humidity when the seeds have just germinated. After about a month the seedlings are up and must be gradually accustomed to the light. Six months after germination, the plants are pricked out and are gradually exposed more and more to the light. At the end of a year, transplanting is often effected, either in order to thin out the nursery beds, or to promote the growth of young plants intended for grafting. After 1½ or 2 years the cinchonas are sufficiently developed and accustomed to the sun to allow of their being finally planted out.

In using seed, even of known origin, there is no absolute certainty of finding the characters of the parent plant reproduced in its descendants. Propagation by seed can therefore not be resorted to if it is necessary to be sure of the characters of the resulting plants. In such cases, recourse is had to propagation by slips of grafting, and by these means plantations consisting entirely of very rich cinchonas can be obtained.

As *C. succirubra* produces the most vigorous trees in Java, it is often used as a stock for *C. ledgeriana*, which is richer in quinine. Since, however, it has been found that the stock exerts some influence on the alkaloid content of the grafted *C. ledgeriana*, attempts are being made to substitute for *C. succirubra* another variety offering still more guarantee for the maintenance of the high alkaloid content. Most of the plantations of *C. ledgeriana* are grafted in this manner. Raising from cuttings requires more care and does not give such satisfactory results,

The trees are planted out at distances of 3 to 5 ft. in holes 12 inches deep. The necessary cultivation work consists in hoeing to prevent the growth of weeds. Sometimes a leguminous cover-crop is taken or castor-oil cake is applied as a manure. On sloping ground, trenches are dug to collect the soil washed down by heavy rains.

After three years, the trees usually become too thick and it is necessary to begin cutting out the lowest branches. Some years later, a certain number of the trees must be removed so as to allow the others to develop normally. In the place of diseased trees, or in gaps due to other causes,

new nursery trees are planted. A ten-year-old plantation thus consists of trees of very different ages and the plantation can be progressively reconstituted and maintained for 25 to 30 years by fresh planting and the felling of unsatisfactory trees.

HOW BARK IS OBTAINED.

Various methods of obtaining the bark have been tried in Java; the best and most commonly practised consists in cutting down the trees to 20 inches from the ground; the stumps and roots are then got up by making a circular trench round them; in this way the bark of the roots is not lost. In the case of *C. ledgeriana* and all the cinchonas used in the manufacture of alkaloids the bark is taken off in strips with a knife; sometimes the bark is so adherent that a wooden mallet must be used to hammer it. The bark of *C. succirubra* is collected with more care in order to obtain rolled pieces about a yard long, called "pipes" or "tubes," the value of which depends upon the length and evenness. The bark intended for pharmaceutical purposes is exposed to the sun to dry slowly, so that the strips roll up well. The bark to be employed for the manufacture of salts of quinine, etc.. is dried in "Siroccos," in which the temperature is kept at about 100° C. A higher temperature would reduce the alkaloid content. In drying, the bark loses an average of 50 to 75 per cent. of its weight.

The yield of a nine-year tree of *C. succirubra* may be estimated at about 21 lb. of dry bark, containing 6 per cent. of alkaloids. In the Government plantations, which are admirably managed, the crop of dry bark is reckoned at 125 lb. per acre after the fifth year. This production rises in the succeeding years till it reaches 300 lb. about the eighth year, and then remains at 370 lb. per acre until the fifteenth or twentieth year. Then the whole plantation is usually cut down and renewed, or else the land is left fallow for some years before being replanted.

For exportation to Europe, the bark of *C. ledgeriana* or other species intended for the manufacture of quinine salts is pounded and packed in bales of 200 lb. The bark to be devoted to pharmaceutical purposes requires more careful treatment; it is well packed in cases, sorted according to its origin into trunk, branch and root bark respectively. The price of this bark is determined chiefly by its external appearance, while that of the other kinds of bark is estimated from their alkaloid content, and from the analysis of a sample taken on their arrival in Europe.

Amongst the insects that attack cinchona plantations the most formidable is *Helopeltis antonii* Sign.; it attacks the leaves, which roll up, turn black and fall. It appears that dense plantations have least to fear from its ravages. *Corticium javanicum* Zimm., a fungus attacking the bark, is especially found when it is very damp. Other fungi attack chiefly the branches and trunks, *Olpidium* being the commonest of them. In the nurseries, if the watering is not carefully done, the young plants fall victims to a fungus described as a species of *Pythium*. Fortunately, so far, the injury caused by insects and fungi has not been of great importance; nevertheless the Dutch Government has appointed to its plantations a botanist to study the diseases of cinchona.

We will conclude this account by giving some figures showing the great development attained by cinchona-growing in Java in a very short period of

time. In 1879 the exports did not amount to more than 60 bales of bark. In 1889 they had already reached $6\frac{1}{2}$ million lb.; the maximum, 20,370,000 lb. was reached in 1910. The fear of over-production and consequent fall in price decreased the quantity exported, which was :

In 1911	...	19,190,000 lb.	In 1913	...	20,900,000 lb.
In 1912	...	19,210,000 lb.	In 1914	...	15,315,000 lb.

In 1913, a contract was made between the planters and the manufacturers with a view to limiting production and maintaining a maximum price ; the effects of this arrangement were already to be seen in the decreased exports of 1914.

The price of the unit of bark, 1 oz., which was 3·81 cents* in 1912, rose to 4·42 cents in 1913 and 6·20 cents in 1914, the latter being a very remunerative price assuring good returns to the present planters.

In 1914, there were in the Dutch Indies 114 plantations belonging to private individuals, 84 of these near Bandong in the West of Java; their total area was 34,030 acres. The Government plantations occupy about 2,570 acres.

While the greater part of the bark is sent to Europe and sold on the Amsterdam and London markets, a certain quantity is sold to a sulphate of quinine factory at Bandong, which is especially trying to monopolise the markets of the Far East. Some of its products are sold for local consumption in the Indies, but most of them are exported. The output was.

1910	...	3,851 cases	1912	...	3,225 cases
1911	...	5,597 cases	1913	...	2,258 cases
1914	...	1,978 cases			

This account of the cultivation of cinchona in Java, although necessarily rather brief, will at least give some idea of the importance to which this industry has attained in the Dutch East Indies, and show that not only suitable climatic conditions and good soil are necessary, but also the careful attention of a provident Government.—BULL. INT. INST. OF AGRIC.

THE BORNEAN CAMPHOR TREE.
(DRYOBALANOPS AROMATICA.)

P. VAN ZON.

In Sumatra, *Dryobalanops aromatica* Gaert. is found in virgin forests consisting of mixed stands sometimes extending over 50 acres. Measurements of Bornean camphor on a trial plot of $\frac{5}{8}$ of an acre gave the following results :—

Average height	...	40 metres (130 ft.)
Average diameter	...	97 cm. (38 in.).
Form factor	...	0·5

The timber is very hard, of a dark red colour, and has a strong odour of turpentine.

"Oil of camphor" is obtained by boring the trunks of trees 20 or more years of age, while camphor itself is found in lumps in crevices and cavities inside the wood.—BULL. INT. INST. OF AGRIC.

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* The Dutch cent = 1/5 of a penny or 2/5 of the American cent.

SCHOOL OF TROPICAL AGRICULTURE.

The School of Tropical Agriculture was opened at Peradeniya on January 15, the Hon'ble Sir Anton Bertram, Attorney-General of Ceylon, presiding at the opening ceremony which was attended by a large number of people from all parts of Ceylon and representative of all professions and industries in the Island.

OPENING OF THE SCHOOL.

SOME OF THE SPEECHES.

SIR ANTON BERTRAM in the course of his speech remarked :—I say to you young men who are joining this school as students, in adopting that study you have done well. In no other place could a School of this description have been founded more appropriately than the country to which you belong, the Island of Ceylon. (Applause.) Ceylon is, and always must be, and I trust always will be, pre-eminently a place for Agriculture. It is in the paddy fields, the coconut groves, and the plantations of Ceylon that the life of the country really exists and not in the streets of Colombo. In all Agricultural countries there grows up a great excrescence in the great cities—in Australia, Melbourne city, and in Ceylon, Colombo. But if we want to see the home of the people of these countries it is to be found in the fields, where Agriculture is carried on. And, therefore, I say it is most appropriate that this new idea, which I believe to be a fruitful idea, is being inaugurated. We shortly shall have an Agricultural College in Peradeniya, but as MR. LYNE pointed out, this is the first step. What we are founding to-day is a gate of that institution through which the youth of Ceylon will pass to enjoy its benefits. MR. HARWARD spoke about the relation of the Agricultural Department to the Department of Education, and said that in his official career he looked forward to this school to promote its growth. I think, however, it will do more than that. I am sure you will concur it is a recognition of the fact that our ideas of education in the past have been too restricted ; that popular education in all countries like this has been altogether too much on literary lines. Education in the past has been too much in the hands of persons of scholastic impulses, and has not been what we are trying to make it nowadays, and what MR. HARWARD told us he was striving to do, his department being in touch with the life of the people and its realities. I repeat, this Agricultural School is a recognition of that fact. It means that in the elementary schools of the country something is going to be done to make the education carried on there more consonant with the lives of the children there. As I looked at the group of these students taken in MR. LYNE's garden a few minutes ago I saw in the midst of it six Vernacular students to whom MR. HARWARD has alluded, clad, not in the picturesque khaki costume of this school, but in the costume of their own villages ; and I saw in those six

Photos by H. F. Macmillan.

MONUMENT ROAD,
Showing the Gardner Memorial in the distance.

View through the Fernery
from the Main Central Drive.

ROYAL BOTANIC GARDENS, PERADENIYA.

[See article *The Home of the School of Tropical Agriculture*, Page 4, "Tropical Agriculturist" for Jan. 1916.]

students the beginning of what I trust will be a great development in education in Ceylon. Mr. Harward told us that these six students were pioneers, and that in time to come all the elementary pupil teachers under the department in Ceylon will go through this training in practical Agriculture, and when they come to teach the children in school it will not be merely book-learning but something more in harmony with the occupations of the pupils when they grow up in later life. I trust also it will mean that, not only in elementary schools, but in secondary schools there will be a recognition of the practical study of Agriculture, the opening up of the secrets of the earth, the exploration by those engaged in the pursuit of Agriculture of those secrets which will open to them new revelations in scientific learning, in the scientific world, which will make them look upon their pursuits with a practical eye and bring to their studies the new principles they find in their scientific pursuits. I hope those principles will be recognised not only in the elementary but secondary schools as well. And when we have an Agricultural College in Peradeniya as a department of the University College we shall then have through the length and breadth of Ceylon an educational element vital to the life of Ceylon. (Applause.) I understand the school we are founding to-day will have three branches. It will have first a Vernacular side where those who are going to be village school teachers will be trained practically in the scientific principles of those pursuits which are more appropriate to the villagers. We shall have further in the school many young men who are destined to become themselves proprietors. They are themselves owners of land and are going to learn agriculture, to put in practice in their estates and fields what they acquire there. There is a third element—those who are going to make Agriculture their career, who are going to earn their living on estates, and who are qualifying themselves in this school for employment in the future work of their lives. I wish them all a successful career, and I think it augurs well for their future from what I can see.—At the conclusion Sir Anton said:—We have heard what Mr. Hew Kennedy, Chairman of the Planters' Association, and Mr. H. L. de Mel, Secretary of the Low-country Products' Association, said. I trust there will be many others, representatives of other Associations, and others who look forward to obtaining for their staffs men of trained intelligence from this institution; and that I trust is the direction in which the school is going to be worked. I trust that this school, begun on a comparatively modest scale to-day, though at present it must be spoken of as an experiment, yet it is an experiment with a certainty of success, for this reason that it has been received so universally as being the right thing in the right place.

Mr. H. L. de Mel said:—On the foundation well and truly laid to-day may there rise a superstructure worthy of the founders and worthy of the builders. The founders have done their duty and will cheerfully impart to you the knowledge they possess and which they have acquired during their researches amidst the magnificent Botanic and Experiment Gardens. On you the students there rests a very serious responsibility and duty. Let me congratulate you in the first place for having decided on this profession and for coming in as pioneer students to-day, to receive an education in agriculture for the express purpose of developing and improving the same for the general prosperity. "What is the best education?" was the question put to Plato many centuries ago. "It is," he replied, "that which gives to the body and

to the soul all the beauty and all the perfection of which they are capable." This statement is true to-day I venture to say as it was then. Is not the study of the possibilities of mother earth and her treasures itself beautiful? You have now decided to put your hands to the plough. Continue then to plod steadily along and not turn back. Give your mind, and your body to perform its best work. May I suggest for your consideration two little thoughts throughout your career. "Bring out the best that is in you." You will, when you go through this course, obtain your certificates and go out to work, be looked upon as agricultural missionaries. Then you must be "by example and precept" a model to your countrymen and therefore you must use the best talents you possess in the truest way. The second point is "to make the best of your environment." The beautiful tropical and sub-tropical array of wealth in this historical Botanical Gardens with such a salubrious climate as to even make it temperate cannot but fail to inspire you with a study of the sciences with which it is allied. Then think of the opportunity you will have of daily meeting the scientific staff of the Department of Agriculture who will be your lecturers, the mingling of thought with thought will stimulate you to action. The avenues of your mind will be open and alert. You will learn to appreciate all the beauties of Nature and the power behind. Having reminded you of some part of your duty it is only right that the public and others interested in local agriculture and prosperity of this island should act reciprocally and give you every encouragement and assurance. You have just heard the Chairman of the Planters' Association, a veritable stronghold of energy, indomitable perseverance and devotion to duty, give you assurance of the British Planters' support. What would the mountain slopes of the Kandyan Provinces be if not for the British Planter? The enormous concessions he has obtained for the people of this country, in obtaining scientific aid in the cultivation of various plantations and the facilities of transport will ever remain a monument to his foresight, energy and perseverance and it is only right that I should bear testimony to that fact on a day like this and ask you to imbibe these excellent traits of the British Planter in Ceylon. You will naturally expect more support of the people of this country. I regret that the chairman of the L.P.A.C. was not able to be present here to give you his assurance but you need no reminding of the fact that the L.P.A.C. have for years been urging the desirability of imparting education to students at Peradeniya. I am sure the Association will continue to give you all the support and encouragement you desire and deserve. As evidence of the practical sympathy towards agriculture as a profession, may I instance to you that the only son of one of our past Chairmen has already qualified in agriculture, obtained a degree and diploma, and taken to the land. The only other chairman who has a son old enough to decide a profession has decided to send him to this School of Agriculture next year. He is not old enough to join this year. I refer to the second son of DR. GERALD DE SARAM. Some of you students will no doubt have to cultivate the acres that have been a goodly heritage from your parents but there are others who will have to place their talents, training and energy at the disposal of the Estate proprietor. For myself I think I can give the assurance that the outlook is extremely hopeful. I can also be responsible for securing billets for at least 10 students. I know a number of other proprietors who will be able to do similarly. In conclusion I wish to thank Government, and the Director of Agriculture for

this important equipment mounted to-day and started to foster the planting industry of Ceylon. I wish the school all success and prosperity. The thought betokens the wish that the school will ripen into a college and the college in course of time will be affiliated to the University of Ceylon and that your successors will be hereafter able to obtain not only a diploma but a degree recognised throughout the world. (Loud applause.)

APPRECIATION FROM *TROPICAL LIFE.*

Hearty congratulations are due to Ceylon and its energetic Director of Agriculture on the way in which they have gone steadily ahead, in spite of the War and the consequent scarcity of money, to secure an agricultural college for Ceylon. Month by month, since we encountered MR. LYNE in Leadenhall Street the day after war was declared, he must have been steadily pegging away until to-day. If they have not yet secured *the* actual college, they have, speaking figuratively, at least laid the egg known as the School of Tropical Agriculture, from which the full-grown and vigorous bird, i.e., the College, will be hatched later on to be developed and expanded as opportunity and funds permit.

From time to time we have seen odd paragraphs in the Ceylon press that led us to hope the idea had not been entirely dropped on account of the War, but we did not realize the progress that had been made until a copy of the prospectus of the School of Tropical Agriculture, at Peradeniya, came to hand. We were agreeably surprised at receiving it.

By it we see that the Director of Agriculture is the Principal, and MR. DRIEBERG, Superintendent of Low-Country Products, the Vice-Principal, whilst the staff of the Department of Agriculture will constitute the lecturing and demonstration staff on the School.

Those who know Ceylon will be interested to hear that the School is situated close to Peradeniya Gardens, on the main road from Colombo to Kandy, ten minutes from the new Peradeniya station. Peradeniya Gardens are nearly a hundred years old, and as they cover an area of 150 acres and contain almost every economic product of importance, the student surely can wish for nothing better as a centre of education, both in the open as well as indoors, as the library has 6,000 volumes, and the herbarium 22,000 floral specimens, whilst other sections have over 10,000 specimens of economic importance.

Such a spot must also be ideal for English students, for Peradeniya is situated some 1,600 or 1,700 ft. up, and enjoys a mean temperature of 75° F. The nights are said to be always cool, and even in the hottest months the days are not too oppressive for study. Candidates for admission must be at least 17 years of age, and have attained a certain standard of education. The fees, payable in advance, are Rs. 30 per month for board and tuition, or Rs. 7·50 for tuition only. At present only a limited number of boarders can be accommodated. Work begins with the school muster at 6-20 a.m., and lights must be out by 10 p.m. Breakfast is at 11 a.m. and dinner at 7 p.m. There is no regular work for Saturdays, but independent investigations and expeditions are expected to be carried out. The course of instruction

includes: the soil, manures and manuring, the plant chemistry, the crops (a wide range, i.e., over seventy in all), pests, diseases, agricultural engineering, stock-raising, co-operation. Demonstrations will be given of how to plant, prune, graft, transplant, fell trees, and many other most necessary things, whilst under the head of planting everything necessary to learn in connection with each of the leading crops will be included; amongst them we note demonstrations in dynamiting for planting, for sub-soiling, blasting rocks and stumps, etc.

We wish the new enterprise every success, and trust that the warmth necessary (i.e., plenty of hard cash) to hatch out this splendid egg will soon be available so that Ceylon, at least, will be able to boast of a fine, full-grown, game College of Tropical Agriculture in its midst, crowing with all its might to draw students to its portals, and challenging Barbados and Trinidad in the West to do likewise, and then sit up to see which of the two birds or colleges is the best.

COCONUT BUTTER.

According to the United States consul at Carlsbad (Austria), most of the coconut butter manufactured in Bohemia is made of Cochin or Indian copra, which is received in large wooden tuns. The dried copra is sliced, and the fat is extracted by oil presses—quite a simple process. This raw oil contains soap fats and does not have a pleasant odor. It is placed in large tanks, and the first step in the refining process is the addition of powdered chalk, which absorbs the soap fats and settles to the bottom of the tank. The oil on the surface is pumped into another tank, passing through four or five filters as the second step in the refining process. It is then forced into a tank heated by steam pipes to about 270 to 318 degrees F. This process continues until the oil is clear as crystal and begins to bubble. It is then pumped into an automatic weighing apparatus and run into the moulds, where it is allowed to cool, the tablets or cubes are removed to the packing table. Part of the oil is run into various sized tubes and is also placed on the market in this form. The soap fats, combined with the chalk, are treated with sulphuric acid, which dissolves the chalk, leaving the fats floating on the surface of the solution. These are drawn off into tubes and are sold to manufacturers of soap. The trimmings of the copra slices are made into a powder, which commands a good price as fodder for cattle and pigs. The coconut fat is white, but when manufactured into butter is colored to resemble oleomargarine. Sesame oil is added to make the product more pliant. Coconut butter keeps well either raw or refined, and does not spoil for months, even in warm weather. It is claimed that ordinary consumers cannot detect the difference between this butter and oleomargarine. Six or seven years ago the output of coconut butter in Austria was about 40 tons a day. It is now approximately 300 tons. The price has increased from £3 15*s* to £5 8*s* 6*d* for 200 lb. The factories claim that they cannot keep up with the demand. The market is controlled practically by two firms—one in Vienna, the other in Aussig.—QUEENSLAND AGRIC. JOURNAL.

GENERAL.

SUDAN DURA.

There are four varieties, white, yellow, close grained and five months, being the easiest way to describe them from their Arabic names. The first three take four months from sowing to harvest, the latter five months.

Uses.—Dura is used for three purposes; flour for bread, green fodder, and grain food for cattle and horses.

Soil.—It should be sown in dry, well drained soil; it dislikes clay and sodden soils.

Sowing.—It can either be sown broadcast in prepared soil and afterwards harrowed in, at the rate of 10 pounds per acre; or it can be sown in shallow, one-inch-deep mamotie holes, one foot apart either way; 3 or 4 seeds in each hole. The holes then should be covered up with the foot and pressed down.

The seed should be soaked in water for one or two days till it shows signs of sprouting when it should be immediately sown.

The best time for sowing is when there is a period ahead of at least $2\frac{1}{2}$ months rain after which there must be a certainty of dry sunny weather in which to harvest. If the crop ripens in the monsoon it will all become mouldy and half will be totally lost. Thus in the Central Province it should be sown early in November, so that it will flower in January and be harvested in March.

Cultivation.—The young plants should be thinned out to two plants in each clump when they are three weeks old, and kept clean weeded. The plants can be transplanted to any vacant places at this period provided there is plenty of rain. Hilling is beneficial but not absolutely necessary, save in the five months' Dura, which owing to its height is apt to be blown over by high winds and requires some support at the roots.

Harvesting.—When the heads are beginning to ripen and the seed is set, the lower leaves can be cut off from the stalk and fed to cattle, who eagerly devour it. Young leaves and shoots must on no account be fed to cattle, as it makes them ill. When the heads are ripening, the birds must be kept away by boys beating tins, as birds are very fond of the sweet soft seeds and will do much damage unless scared away.

When the heads are quite ripe they may be cut off close, conveyed to the threshing floor and allowed to dry in the sun before being threshed by cattle or by hand. The stalks must be pulled up and when dry burnt on the field.

Storing.—Care must be taken in storing the grain, as weevil are extremely fond of it and will cause great damage. If kept in sacks the stock must be examined every few weeks and if there is a sign of weevil it must be spread in the sun and plantain leaves spread near by. The weevil will seek the shade under the leaves where they can easily be collected and destroyed.

The best way to store it and that which is employed all over Africa is to build a mud construction like that employed in Ceylon villages for storing paddy (bissa). It must be raised from the ground on stakes supporting a platform of woven split sticks or cane. On this is erected upright canes either round or square and the whole plastered with mud and a final coating of cow dung.

An upward slanting hole should be made at the bottom with a wooden plug so that the weekly or daily dole of grain can be easily obtained without taking off the top and thus letting in damp or chance insects. As soon as the grain is threshed and thoroughly dry the construction should be filled up and a mud lid put on and sealed up with mud. The whole should have a cadjan or straw shelter from the rain. These grain stores will last for many years when once made and will keep the grain sweet, dry and free from insects for any length of period.

Consumption.—The grain is easily ground to a fine flour by ordinary native methods. In the Soudan it is daily ground on stones with a little water. The thick paste is then diluted with water to a thin paste and round, thin pancakes of bread are made on an iron plate over a fire. But it makes very good ordinary baked bread, without the use of yeast. It is very strengthening and sweet and not heating as is maize flour, and is very easily digested.

Cattle, horses, sheep, goats and poultry eat it with avidity and it will keep them in splendid condition.

Pests.—The Dura is attacked by an aphis or green-fly blight, but this will not do much damage, save in causing some of the leaves to turn black and render them unfit for fodder.

THE FIVE MONTHS' VARIETY.

This must of course be sown a month earlier. It is much taller than the other varieties and yields abundant green fodder and very big heads of large grain. But it naturally takes much more out of the soil than the others.

D. S. CORLETT.

ENDEMISM AND EVOLUTION.

The phanerogamic flora of the tropical island of Ceylon is very well known, and therefore affords data almost unequalled for statistical investigations and comparisons. Ceylon has engaged the attention of botanists from BURMANN (1737) and LINNÆUS (1747), through successive Directors of the Botanic Gardens down to DR. J. C. WILLIS, who continues his studies in the paper the title of which is given below.* Incidentally, it may be mentioned that Ceylon is about half the size of England, with mountains rising to an altitude of about 8,000 feet, and the latest statistics of the phanerogamic flora are: 2,809 species belonging to 1,027 genera and 149 families. DR. WILLIS's discussion of the endemic or peculiar element is highly interesting; though he starts on the erroneous assumption that Ceylon "contains an immense endemic flora, which enables it to rank with many oceanic islands: even the Sandwich Islands have not so many." He himself places the total number of endemic species at 809, which works out to 28·8 per cent., and, it may be added, only 23 genera are peculiar to the island. The percentage of endemic species in the flora of India is approximately sixty, in that of Central America seventy, and in that of the Sandwich Islands upwards of eighty. The highest degree of endemism, excluding small insular floras, such as that of St. Helena, obtains in West Australia, where it approaches eighty-five per cent. It is true that the flora of Ceylon comprises a larger number of endemic species of flowering plants than the Sandwich Islands; but it must not be forgotten that the total number of species in the former is four times that in the latter. However, these proportions do not affect the author's arguments in relation to endemism and evolution. His main point is that the

* "The Endemic Flora of Ceylon, with reference to Geographical Distribution and Evolution in General," by J. C. WILLIS, M.A., SC.D., PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY OF LONDON. Series B, Vol. ccvi., pp. 307—342. 1915.

endemic species are, on the whole, much rarer than those of wider distribution, and that this fact is apparently destructive of the theory of natural selection and adaptation. For purposes of comparison DR. WILLIS groups the species under three heads, namely, endemic to Ceylon, common to Ceylon and Peninsular India, and those of wider distribution. Then, in relation to commonness, he follows TRIMEN in classifying each group under six degrees of rarity, beginning with "very common" and ending with "very rare." The results are exceedingly interesting and suggestive, and we reproduce his opening tabular view of the number of species in each group and class :—

	Endemic in Ceylon.	Restricted to Ceylon and Peninsular India.	Of wider distribution.
Very common	19	45	221
Common	90	118	462
Rather common	139	103	313
Rather rare	136	84	209
Rare	192	64	159
Very rare	233	78	144
	809	492	1,508

DR. WILLIS's deduction from this and other statistical data is that the endemic element has not developed "in any kind of advantageous response to local conditions, as must have occurred did natural selection obtain." The table shows that the endemic species increase in numbers from "very common" to "very rare," more than a quarter coming under the latter category, whereas those of wider distribution increase in numbers in the inverse direction. Degree of commonness WILLIS regards as the criterion of age. Thus the endemic element in the flora would be the youngest of the three series. The subject of evolution and distribution is so complex that we will only suggest that the converse might afford an equally probable explanation of the present conditions. Many endemic types now exist only in very small numbers. Coleus elongatus is given as an example of one that "must have evolved on the summit of Ritigala, where it exists as about a dozen individuals, and cannot ever have been much more numerous." We agree with the author that natural selection has not played an important part in the present distribution, and the term "survival of the fittest" is not a happy one.

The present vegetation of New Zealand offers a striking example of the changes effected by a foreign element. Upwards of 600 species of foreign flowering plants are now more or less completely naturalised in New Zealand, and competing with the native plants for existence. In some localities introduced plants have completely ousted the native vegetation. At least 75 per cent. of the native species of flowering plants and ferns are peculiar, and they comprise every type of vegetation, from the lowliest herb to the loftiest tree. Many are common throughout the islands in suitable altitudes. Numerous others have hitherto been collected in only one locality and may be classed as rare though future explorations may reveal a wider distribution of some of these. Now it is well known that the presence in New Zealand of many plants of wide distribution is of comparatively recent date; yet in many localities they are rapidly replacing the endemic plants. The late THOMAS KIRK was a keen observer and recorder of biological phenomena in New Zealand, and he emphasises the fact that such robust native plants as Phormium tenax, Cyperus ustulatus, Aciphylla

squarrosa and Pteris esculenta are displaced by European grasses and Clover. This is probably in part due to augmented vitality and fertility in "fresh soil." The endemic element of the New Zealand flora presents some very curious features in its composition, including, possibly, many of the oldest species, as well as the youngest, and some of the rarest as well as some of the commonest species; many belonging to genera of world-wide range; many to endemic or exclusively southern genera.—GARDENERS' CHRONICLE.

THE SAHARA DESERT.

FRANK R. CANA.

The size of the Sahara is indeed hardly realised. It covers approximately 3,500,000 square miles and is not much inferior in area to the continent of Europe. Though sand extends over probably 700,000 square miles, rocky plateaux and not sand-dunes are the chief characteristics of the desert. If a generalisation be attempted, the Sahara may be described as a great tableland scored by the beds of dried-up rivers, diversified by mountains and depressions, and fringed by a deep belt of sand west, north and east. Southward there is generally an intermediate zone between "the desert and the sown." The higher plateau and the mountain ranges occupy a central position and extend across the Sahara north-west to south-east. This elevated region is sometimes spoken of as the bridge connecting the Mediterranean lands with Central Africa, the means by which early man spanned the desert. It is hardly a continuous bridge and there is scant evidence of its use as a means of communication in historic times. It had by then probably served its purpose.

POSSIBILITIES OF LAND.

Regarded from the point of view of the contribution it may make to the world's wealth the Sahara does not seem a promising field. Yet it possesses one thing for which there is a great and apparently increasing market—dates. There are many millions of date-palms in the Sahara: millions more might be grown, and the Sahara dates are unequalled in quality. The difficulty is in getting them to market, and such railways as that recently opened to Tuggurt give the needed facilities. Information given by COMMANDANT GODEFROY—who both surveyed and built the Tuggurt line—with regard to the production of Rhir oases may be given as typical of the work carried out by France in the Algerian Sahara generally. In 1856 the Rhir had 200 wells and 339,000 date palms. In 1914 there were over 800 wells and nearly 1,500,000 palms Since the French occupation the production of dates had nearly quadrupled and was in 1914 some 30,000 tons. This was accomplished before the railway gave the people of Rhir the chance of putting their dates on the market. This year it was anticipated that 8,000 to 10,000 tons of dates, worth about £16 a ton, would be exported from Rhir, and with the coming of the railway the area of plantation can be very largely increased. COMMANDANT GODEFROY estimates that the Rhir can produce for exportation dates worth nearly £500,000 yearly. Already some French colonists have acquired palm groves. This example of what can be done in one oasis must serve to indicate what is being done in many others. When all the oases in the Moroccan, Algerian, and Tunisian oases are brought to full productivity and given easy means of access to the North African ports, the date industry should attain proportions as large as any demands made upon it. More distant oases can also be made more flourishing and thus able to support a larger population—all needing European goods.

The date palm is rightly called the monarch of the Sahara, but it has subjects. A great variety of fruits—peaches, grapes, oranges, figs, and the more hardy apple, etc.—are grown in the oases, and there are possibilities of

a valuable export trade in them. Moreover, a large range of crops from wheat and barley to rice and durra can be grown. These will not become exports but if all the chances of cultivation were seized the Sahara could support a much larger population than it now does. Two things are requisite for the cultivation of the oases to their fullest capacity—water and security of tenure. The French are providing both. Besides the sinking of artesian wells, the usual method of getting new supplies of water in the oases, surface irrigation works are being undertaken in Tuat where there is a large supply of river water.

Another source of sylvan wealth is afforded by the gum acacias. These are found in oases but chiefly in the intermediate zone bordering the Sudan. In these regions too are found the ostriches whose feathers have for centuries been one of the chief articles of Saharan commerce. There is no reason why ostrich farming in this "strip of herbage strown" should not become very valuable. In Mauritania many of the uplands appear to be suitable for stock-raising on a large scale and Port Etienne and Villa Cisernos afford convenient harbours for their export. The thousands of camels, asses, goats and sheep possessed by certain tribes proved the existence of large areas of pasturages. The present trade in hides and skins is obviously capable of material expansion. Probably esparto might be cultivated here as it is in the Algerian plateaux, and Mauritania with its harbour of Port Etienne seems to deserve to be supplied with a railway system.

Although the Sahara may be the least curable of deserts, actually the area where increased cultivation of the soil is possible and would be profitable is large. It cannot well be less than a tenth of the whole area—say 350,000 square miles, or something less than the combined area of France and Spain. This would include the Sahel Sudanese, the intermediate zone mentioned several times already. There appears to be no sufficient climatic reasons to prevent Fezzan, the Zinder district, the Aïr highlands, and the Walata valley recovering the prosperity they formerly possessed. The region of the Middle Niger—the backwaters and lakes which extend westward of Timbuktu—could at comparatively little cost be placed under irrigation. Means could in all probability be found for resorting to cultivation of large areas between Lake Chad and Borku. In the bed of the Bahr el Ghazel wells already exist and their number could be increased by boring. Efforts to regenerate the intermediate zone are, naturally, likely to take second place to the development of the richer regions further south, but work in that zone has the recommendation that it will form a protection against further encroachment by the desert.

As to mineral wealth the Sahara is rich in salt. Phosphates, potash and soda are found; the great beds of phosphates exploited in Algeria and Tunisia lie on the Saharan border. There is a regular export of potash from Aïr to Nigeria. Gold and precious minerals were mined by the ancient Egyptians in the hills facing the Red Sea and gold-mining on a small scale has begun again in the Nubian Desert. Soda in large quantities is obtained from the Natron lakes west of Cairo, from the Chad district and other regions. Petroleum-bearing strata are believed to exist. But the mineral resources of the Sahara are practically unknown, though the belief that they are great is probably well founded.

When all has been done for the economic development of the Sahara which is possible, when France, Great Britain, and Italy between them maintain peace throughout its wide extent, when a population ten times as numerous as it now is finds in it means of support, the desert will in outward aspect be little altered. It will remain a land of immense solitudes and boundless horizons, of strange dead mountains and dry river-beds, of verdant oases, waving palms and ever-receding mirages—a land of heat and thirst, of rock and dune, in which the tents of the nomads and the caravans of camels will leave a more lasting impression than the lines of steel which bind it anew to the outer world.—THE GEOGRAPHICAL JOURNAL.

THE WAR AND GERMAN AGRICULTURE.

So much has been and is being written on the real or imaginary shortage in Germany of food commodities that it is well that an official statement should be issued. Such a statement appears in the JOURNAL OF THE BOARD OF AGRICULTURE (November 1915), but is, unfortunately, unsigned. Hence it is difficult to estimate the value of the conclusions which it contains.

From the article we learn that in normal times Germany imported only about one-tenth of her feeding stuffs for man and beast, but that, inasmuch as war was declared before the harvest had been gathered in, the deficiency —owing to mobilisation—was greater than one-tenth.

On the other hand, much of the food normally destined for feeding of stock is suitable for human consumption—barley, oats, potatoes, etc. Hence by slaughtering a sufficient number of animals scarcity might have been prevented. This was not done until actual scarcity had declared itself, but in January, 1915, the danger was recognised and steps taken to reduce the number of swine. Potatoes, of which Germany produces a quantity greater than that raised by any other country, might have served to repair the deficiency, but in the earlier days of the war farmers were encouraged to feed their surplus to stock, and it was not till later that it was realised by the authorities that the potato stocks, properly handled, would serve to make good the deficiency in corn.

The patriotism of the German was not sufficient to overcome the desire on the part of those holding potatoes to make large profits, and on the Government deciding to purchase potatoes at a certain price, only small quantities were forthcoming. Farmers were holding their stocks in the hope of better prices. Later on, after a bout of speculation, there was a potato panic ; prices fell, and the Government potato department found large stocks left on their hands. Much of this surplus was used, however, for the making of dried potato flakes, which are of good keeping quality. This year's harvest is not believed to be up to normal, owing to shortage of labour and draught-animals and scarcity of nitrogenous and phosphatic manures.

Elaborate measures have now been taken to ensure the most economical application of foodstuffs, by regulating the feeding of stock, fixing minimum prices for wheat, rye, etc., prescribing rations for dwellers in towns, drying large quantities of potatoes and reserving them until spring and making large use of the forests as feeding-grounds for pigs.

The article concludes with the comment that although they blundered at the beginning the officials have displayed energy and competence in dealing with what was and no doubt is a difficult situation.—GARDENERS' CHRONICLE.

MOTOR PLOUGHS AND TRACTORS.

As a result of suggestions made by the Board of Agriculture and Fisheries demonstrations of labour-saving machinery have recently been carried out by the County Councils of Lincoln (Lindsey), Essex, and Northants, the Suffolk Agricultural Association in conjunction with the East Suffolk County Council, and the University of Cambridge. (Since the date of writing, another demonstration has been held in Yorkshire under the auspices of the Yorkshire Agricultural Society and the Yorkshire Council for Agricultural Education.)

Although such labour-saving devices as potato diggers, dung spreaders a turnip-topping and tailing machine, a turnip thinner and horse hoe, a root cleaner and cutter, a hedge cutter for horse power, a pig-feeding machine, milking machines, and model silos were exhibited, the demonstrations had regard chiefly to motor ploughs and tractors.

From the point of view of the attendance and interest aroused on the part of farmers, the demonstrations were all extremely successful; thus, it is estimated that over 1,000 people were present at each of the two demonstrations in Lincolnshire, and at Chelmsford the attendance numbered some 400 to 500, including members of the Departmental Committee on the Home Production of Food. Several hundreds were also present at the other demonstrations.

The conditions under which the trials of motor ploughs and tractors took place were, perhaps, too favourable for definite conclusions to be formed as to the general usefulness of the various machines. The weather was fine in all cases, and the land generally dry; the soils were, as a rule, light, but in the Cambridge demonstration the soil was a heavy loam, in places changing to a heavy clay, and in others to a lighter loam. It must, of course, be remembered, on the other hand, that wet weather need not seriously interfere with the employment of motor ploughs and tractors, since the work may be done sufficiently quickly to be accomplished in spells of fine weather. It is probable that the motor ploughs and the lighter tractors will usually be workable under the same weather conditions as horse-drawn ploughs. The soil in the Cambridge demonstration was so hard that it was doubtful whether horse ploughs would have worked successfully. Cross ploughing, and the ploughing-in of dung, were not tested in these demonstrations.

The number of machines tested was affected by the difficulty experienced by manufacturers in supplying machines and men, and by difficulties of transit. In some cases the railway companies were able to afford special facilities for delivery.

The prices of the motor ploughs (combining plough and motor in one) tested are lower than those of the tractors (i.e., without ploughs); the motor plough would probably be most suitable where the ploughing can be spread over several months. On the other hand, the tractor is favoured where large areas have to be ploughed quickly, and where there is much haulage and threshing to be done.

Various particulars as to the motor ploughs and tractors are given in the table on the next page.

Demonstrations of the FOWLER-WYLES MOTOR PLOUGH were given at Frithville (Lincolnshire), and Bramford (East Suffolk), at both of which places it did good work. The motor drives two spiked wheels, and is very simply controlled with one lever by a man sitting at the rear; the plough may be used for either single or double-furrow work. Its small size (3 ft. high by 2 ft. 4 in. wide) allows of its employment in hop gardens and orchards where horses are less suitable. It seems to be capable of ploughing about 3 acres per day. Various kinds of farm work other than ploughing, e.g., cultivating are possible. When not in use in the fields the engine may be used for grinding, chaff cutting, etc.

The WYLES MOTOR PLOUGH is similar in type to the foregoing, and is adapted for the same kinds of field work. It is, however, fitted with a more powerful engine. It did very good work at Chelmsford. A suitable pulley is attached for belt driving.

Name.	Manufacturers.	H.P. (h.p. at drawbar in brackets.)	Weight.	Fuel.	Plough.	Price.
Motor Ploughs.			T. C.			£
"Fowler-Wyles" Plough -	John Fowler & Co., (Leeds), Ltd. -	8—9	16	Petrol or benzol.	2 furrow	158
Wyles Motor Plough -	Wyles Motor Ploughs, Ltd., Manchester -	11—12	1 2	" "	2 "	172
Martin's Motor Plough -	Martin's Cultivator Co., Stamford -	15—16	—	Petrol	2 "	200
Crawley's Motor Plough -	Crawley Bros., Hadstock - -	30	1 10	"	3 "	—
Tractors.						
Weeks-Dungey "Simplex"	Weeks & Son, Ltd., Maidstone -	22½	1 5	"	2-3 "	210
"Big-Bull" or "John Bull"	(Agents) Cyrus Robinson & Co., 61, Holland Road, London, W. -	20 (7)	2 0	"	3 "	230
"Mogul" - -	International Harvester Co., London-	25	4 5	Paraffin or petrol	3-5 "	400
"Daimler" - -	Daimler Co., Ltd., Coventry -	40	4 10	Petrol	4 "	600
Saunderson's "Universal" Model "G" -	Saunderson & Mills, Ltd., Bedford -	20	2 15	Mineral spirit or paraffin	3-4 "	325
"Sandusky" - -	(Agents) Mills & Son, Ltd., Paddington	brake 40—45 (15)	3 10	Petrol	4 "	578
"Overtime" -	Overtime Farm Traction Co., London	24 (12)	2 3	Paraffin	3 "	231
"Ivel" - -	The Ivel Agricultural Motors, Ltd., Biggleswade - -	24	1 17	"	3 "	265
Mann's Steam Tractor -	Mann's Patent Steam Cart and Wagon Co., Ltd., Leeds -	—	4 10	Coal or coke	4 "	—
Ransome's Steam Tractor -	Ransome, Sims & Jeffries, Ipswich -	—	4 15	"	4 "	—

Martin's Motor Plough was exhibited at Frithville, Appleby (Lincolnshire), Cambridge, and Bramford, and did good work. The feature of this machine is that it obtains its motion from an endless chain or "creeper" 6 in. wide, giving a 3-ft. continuous tread. There is a creeper on each side, and the one in the furrow has a tendency to break up the soil rather than solidify it. The creeper device worked well on dry, light land, and when the plough was replaced by a cultivator the engine drew this readily through the freshly-ploughed ground without injury to the soil. At Appleby, although some time was occupied in examination and enquiries, it ploughed $1\frac{1}{2}$ acres in 4 hours (double furrow).

Each of the foregoing machines is easily worked by one man; the consumption of petrol per acre varies from about $1\frac{1}{2}$ gal. to $2\frac{1}{2}$ gal. They can turn readily on a 4-yd. to 5-yd. headland, and appeared to be better adapted than tractors for small fields, hilly land, and land on the ridge-system.

Crawley's Motor Plough, also self-contained, and manipulated by one man, did excellently at Chelmsford, and attracted much attention at Cambridge, where it worked powerfully, and drew a 3-furrow plough on all the classes of soil at considerable speed. It has evidently plenty of power, and is capable of ploughing the heaviest classes of soil satisfactorily. It seems easy to control, and requires a narrow headland.

The Weeks-Dungey "Simplex" Tractor.—This is a compact machine, measuring 7 ft. 4 in. long by 4 ft. wide, and 4 ft. 9 in. high; it was generally liked at the Frithville demonstration for its compactness, and was, in fact, one of the best of the small type machines. Three speeds forward, and one reverse are provided, and, although some doubt was expressed at Frithville as to its ability to work in wet weather without slipping, the makers claim that the speed attachments overcome this difficulty. At Frithville, Appleby, Cambridge, Northants, and East Suffolk (the demonstrations in which it was tried) it did good work, and required very small headlands. Under the conditions in which it was tried, the engine was easily capable of pulling the double-furrow plough, although not so fast at Appleby as the "Bull." The machine appears useful for slow haulage work; it is said to be able to pull 5 tons on the level. Two men were required for ploughing.

The Big Bull Tractor is a 3-wheeled machine with a powerful engine, capable of pulling a 3-furrow plough; its length is 13 ft. 11 in., and height 6 ft. 3 in. The driving wheel and the single-steering wheel run in the furrow, and do not pack the land.

Some Lincolnshire farmers thought that this arrangement of the driving and steering wheels, although generally commendable, might be disadvantageous under certain conditions by consolidating the furrow bottom too much; on the other hand, it was noted at Cambridge, on the heaviest part of the land, that the single-tractor wheel in the furrow seemed inclined to churn up the subsoil.

The fact of the driving wheel running in line with the steering wheel makes the tractor automatically self-steering; it only needs driving round the ends. The tractor required 2 men to handle in the demonstrations, though the makers claim that 1 man can do the work when their own plough is fitted.

At Cambridge the tractor drew a 2-furrow plough, and ploughed a greater area than any other machine, working steadily through the day. At Appleby, 3 acres of land were well ploughed 5 in. deep in $4\frac{1}{2}$ hours; in a test in Lincolnshire earlier in the year, 1 acre was ploughed in 1 hour 50 minutes, a little over 2 gallons of petrol being consumed. The tractor left a narrow headland at Appleby, but was not particularly handy at the headland at Cambridge.

A point which was not tested was as to whether a 3-wheeled tractor is desirable for really stiff soil. Further, in Lincoln, the question was raised as to whether a 3-wheeled tractor is equal to a 4-wheeled one for haulage purposes, but apparently the draw chain adjustment at the back permits of an even and direct pull, and the single steering wheel is no advantage. The question of backing the machine might be a difficulty in reaping.

A feature of the machine is the ease with which the working parts may be inspected.

The Mogul Tractor is a very powerful machine pulling a 4-furrow plough. It is started on petrol, and runs on paraffin. It has 2 speeds forward, and 1 reverse. It is easily handled, having a steering mechanism of the motor-car type; all the working parts are well protected. It was tested at Frithville, Chelmsford, Moulton (Northants), and Bramford, and did good work. On account of its heavy weight, however, the wheels are apt unduly to pack the land. It was rather slow at Frithville, and, although ploughing 4 furrows against the "Bull's" 3 furrows, it did not get so much work as the latter. It is too heavy a machine for small occupiers, and probably too expensive for ordinary farmers. The tractor can haul 10 tons on level roads.

The Daimler Tractor is another machine which is very heavy, and expensive for ordinary farmers; the makers intend to turn out a smaller and lighter machine after the war. However, it did very satisfactory work at the Lincoln demonstrations (it was not tried elsewhere), ploughing about 1 acre per hour. It pulls a 4-furrow plough. No delivery of these tractors can be obtained at present.

The Saunderson and Mills "Universal" (Model G) Tractor was tested at Frithville, Chelmsford, and Moulton. It was regarded, both at Frithville and Chelmsford, as an exceedingly useful general purpose machine, and it seems to be one of the best of the more expensive types. An advantage is that it works on paraffin, the consumption of which, in ploughing, was put at 3 gallons per acre at Moulton, and about 4 gallons per acre at Chelmsford. The 1915 type of machine is stated to be a great improvement on older types. At Moulton it drew a 3-furrow plough at the rate of about $\frac{3}{4}$-acre per hour. It has 3 speed gears of approximately 2, 3, and 5 miles per hour forward, and 3 reverse speeds. It will haul a load of 5 or 6 tons at the rate of 5 miles per hour, and drive a 4-ft. 6-in. threshing machine.

The very powerful *Sandusky Tractor* was tried at Frithville, and pulled a 4-furrow plough with ease; the plough was fitted with a patent lever apparatus for lifting all the ploughs out of work, and letting them in again at the headlands, which does away with the necessity of a man at the ploughs. This tractor again seems too heavy and expensive for the ordinary farmer. It did much less than 1 acre per hour at Frithville. The wheels skidded on the loose soil surface when a trial of deep ploughing (10 in.) with a 3-furrow plough was carried out.

Good work was done by the *Ivel Tractor* at Chelmsford. This tractor has been before the public for 11 years, and its merits are well known.

The *Overtime* was tried at Moulton and Bramford, its work being very favourably commented upon. It drew a 3-furrow plough with ease, but required 2 men. As a light tractor at a moderate price it appears to be one of the most useful on the market.

Ransome's Steam Tractor was tried at Bramford. The soil, though light, was somewhat soft as a result of heavy rain the day before the trial, and the tractor was unable to demonstrate its powers. On firm, level land, however, there is reason to believe that this tractor is capable of doing good work.

The *Mann Steam Tractor* pulled a 4-furrow plough at Frithville, and did good work, but it is generally held to be more adapted to road work than ploughing. However, it ploughed evenly and well, and satisfied many of the larger farmers.—JOURNAL OF THE BOARD OF AGRICULTURE.

PROGRESS REPORT, PERADENIYA EXPERIMENT STATION.

From October 15 to December 15, 1915.

TEA.

The yield for the month of October was 2,271 lb. green leaf and for November 4,553 from 5 acres and tippings. The October made tea fetched in Colombo 45 cents per lb., for broken orange pekoe, and an average of 39·11 cents for all grades. That for November 57 cents per lb. and an average 49 of 49·23. All fifteen plots are now in full bearing.

RUBBER.

Plots 73-77 have been thickly sown in cow-pea to be cut and mulched to the trees before the dry weather.

In November the Tephrosia candida in all other plots was cut and mulched for the eleventh time.

31 trees have been attacked by bark-rot; the method of prevention is under discussion.

COCOA.

Pickings have continued fortnightly. Pod fungus has shown a remarkable decrease over last year in all the plots. In plot 1 for October and November, 1914, there were respectively 50 and 470 fungus pods and in 1915, 132 and 122. In plot 2 for October and November 86 and 900 in 1914 and 144 and 40 in 1915. The rainfall for October and November, 1914, respectively was 11·87 in. and 7·41 in. and for 1915 5·88 in. and 12·21 in. It will be noticed that as regards amount of rain the months changed places in 1915. In 1914 there was heavy rain in October and less fungus pod and in November less rain and more fungus. This is as it should be as the fungus engendered by the wet October would manifest itself the following month. But in 1915 the comparatively small rainfall in October resulted in a decrease of fungus pods in November.

The decrease is therefore probably largely due to the dadap shade having been heavily lopped in October just before the North-east Monsoon, and to regular fortnightly pickings preventing the spread of the fungus.

COFFEE.

The dadaps in the new plots have been pruned and the loppings mulched to the young trees. The young plants show a healthy growth in spite of the green-scale which is being kept in check by spreading the fungus *Cephalosporium*. Some coffee leaves bearing this fungus have been sent to a planter near Kandy whose new coffee plantation was becoming infested with green-scale. He writes:—"In three days the fungus began to spread and on the fourth day had travelled to a bush 50 feet away." Further progress will be reported later on.

Twenty-five plants of Arabian coffee have been received from Hakgala Gardens and planted 10 ft. x 10 ft. under dadap shade.

The Hybrid bushes round the show plots are being cropped. The bushes are divided into those most resembling the Arabian parent and those the Liberian, in order to test the flavour. One bush yielded a crop of $11\frac{1}{2}$ lb. green berry at one picking which, when sun-dried, gave a weight of $5\frac{1}{4}$ lb.

COCONUTS.

All the plots in the young palm plantation have been well disced and cleaned and the older palms are in heavy bearing. All mana-grass has been pulled up again for the third time on the hill-side.

PADDY.

The field continues to look in first-class condition. During a very heavy rain-storm the drain worked very well in carrying off the storm water quickly and preventing any flooding or beating down of the crop.

The Hondarawala paddy is in flower, 99 days after sowing. The plot has been badly attacked by the rice-bug (*Leptocoriea varicornis*). All grass and weeds on the banks are being cleared away and on the advice of MR. HENRY, Acting Government Entomologist, trials with nets to sweep over the fields to catch the pests are being made. Results and further details will be published later on.

PLANTAINS.

The Hondarawala variety, hitherto immune from the banana disease (Fusarium) has now been attacked.

PAPAW PLOT.

The tapping for papain has now been discontinued as the trees were getting too tall and the number of fruits very few. A total quantity of 19 lb. was collected and sold for Rs. 3/50 per lb. The results will be published later.

ECONOMIC PLOTS.

Four varieties of cotton have been sown, Sea Island, Durang, Allen's Long-Staple and Cambodia.

The groundnuts were harvested in 5 months from sowing and the plots re-sown with the addition of Mauritius variety. The Spanish variety gave very fine large nuts, the Ceylon, a medium sized one, and the Virginia Bunch the smallest.

The small yield from Virginia Bunch is probably due to the fact that the seeds were not sown close enough and the plants should have been earthed up to counteract their erect habit of growth, which prevents the flowers from being able to form their seeds in the earth.

The following is the result :—

Spanish Nuts.

316 sq. yards gave	74	lb. fresh nuts
	23·5	,, dry ,,
	50·5	,, loss on drying, or 68·2 %

This yield is equivalent to 1,135 lb. of fresh nuts or 360 lb. of dry nuts per acre.

The nuts consisted of	shells	31·3 %
	kernels	68·7 %

so that the yield per acre of dry kernels equalled 247 lb.

Virginia Bunch.

264 sq. yards gave	27·50	lb. fresh nuts
	15·75	,, dry ,,
	11·75	,, loss on drying, or 42·7 %

The yield is equal to 506 lb. per acre of fresh nuts or 290 lb. of dry nuts. The yield per acre of dry kernels equalled 199 lb.

Ceylon Variety.

159 sq. yards gave	98·00	lb. fresh nuts
	51·25	,, dry ,,
	46·75	,, loss on drying, or 47·6 %

The yield is equivalent to 2,980 lb. of fresh or 1,560 lb. of dry nuts per acre. The yield per acre of dry kernels was 1,071 lb.

The last plot of 159 square yards or about 1/30th of an acre cost Rs. 1/74 to hand dig and gather the crop of $51\frac{1}{4}$ lb. of dry nuts. Taking one bushel of unhusked nuts at 24 lb. the cost per bushel equals 78 cents; so that 1,560 lb. or 68 bushels would cost Rs. 50/- per acre.

Allowing Rs. 2/50 per bushel as the value of the dried nuts, the return per acre is Rs. 170/- less Rs. 53/-, or a net profit of Rs. 117/- per acre.

Taking the cost of digging and collecting as the same in each case, the respective profits per acre would be, assuming the percentage of oil being the same in each case:—

	Yield per acre bushels	Weight per bushel lb.	Costing Rs. c.	Value Rs. c.	Profit per acre Rs. c.
Spanish Peanuts...	21	$17\frac{1}{2}$	16·40	39·00	22·60
Virginia Bunch...	12·6	24	9·80	31·50	21·70
Ceylon Variety...	68	24	53·00	170·00	177·00

A determination of the percentage of oil in the seed and of nitrogen, etc, in the cake of each kind is being made.

VANILLA.

Several of the vines flowered in October and November, but the spring is the usual season. Those that flowered in May are ready for harvest.

The Temple-tree cuttings (Plumeria) planted to take the place of the dadaps have now become well established and the vines are gradually being transferred to them whilst the dadaps are being lopped down and mulched to the plants.

The Plumeria has also made a good growth in that portion of the plot where the soil is so poor that the dadaps failed to become properly established.

A plot of Sesbania grandiflora (agati) has been sown to act as supports for vanilla, pepper, and betel with T. candida intersown to see the effect of green-manuring on these vines, which should respond readily to a green leguminous mulch.

DUDLEY S. CORLETT,

Manager, Experiment Station, Peradeniya.

MILK FEVER IN DAIRY COWS.

A. A. JOHNSON.

Firstly let me say definitely that the term "milk fever" is a complete misnomer, because the "fever" is conspicuous by its absence in this disease and the thermometer registers as a rule a temperature that is subnormal, indicating the complete collapse of the body functions. A better description of the disease is that of parturient apoplexy, or parturient collapse, the former designation implying an unconscious following on the act of calving, the latter a collapse at this period.

This disease has been described by writers for upwards of a century, and has at the present moment become increasingly prevalent, thanks to the improvement in the milking qualities of the dairy cow, and the life of ease

that it leads. Still even to-day we are in doubt as to the actual causes that bring about the condition. Scientists in all lands have argued and experimented, but a combination of circumstances having to be present to bring about an attack, it would seem that to any one of the factors might be correctly ascribed the causation of the disease. The extraordinary success attending the treatment of the udder would lead one to believe that the starting point of the disease lies in that organ, while the ensuing symptoms of brain disturbance and paralysis of the nerve centres would also support the theory that the blood and nervous systems were affected to a great extent.

A review of the symptoms is unnecessary, but the fact may be stated that certain conditions influence the onset of the trouble, and that farmers keeping their cows under certain conditions may expect some of them to develop the disease at some period or other. The prevention of parturient collapse or milk fever is really of more importance than its treatment. The cows attacked are usually deep milkers, and the third calving is the most likely period for commencement. Thereafter, each calving may produce symptoms more or less serious according to the condition of the cow. A plethoric, rich state of the blood seems to be a necessary adjunct, while want of exercise is also one of the predisposing causes. I do not think any one breed is more predisposed than another, and though possibly more Jersey cows are affected than other breeds, the fact that this breed is largely kept by the "one-cow-owner," and therefore is more likely to be overfed, accounts for the increase. Milking the cow dry is undoubtedly a predisposing factor, and is obviously a disregard of nature's intentions.

As regards treatment, the injection of air into the udder is now so well known and its beneficent results so widely distributed that one need hardly refer to it, except to remind owners of cattle that are likely to be affected that there are many forms of apparatus on the market which can be obtained at a small cost. These render unnecessary the introduction of germs into the udder, with the consequent loss of a quarter so often experienced after the use of a bicycle pump and valve. The air introduced should be sterilised by being passed through aseptic wool, the teat syphon boiled before introduction, the udder well washed and cleansed with antiseptic. Then the milk should be withdrawn from the udder, which is then distended with air. After distension it is usual to tie the teats to prevent its egress, but in many cases this is unnecessary, as the mechanism that prevents the egress of milk will, as a rule, prevent the emission of air. However, if the teats are tied with tape, see that it is in the form of a broad band, and do not leave it on for more than a few hours. Removal of the urine and the administration of an enema of warm water should never be omitted. The cow should be turned from one side to the other every few hours, and packed up so that she cannot lie stretched out upon her side. The injection of air should be repeated in about eight hours' time if the cow does not rise, and no medicine should be administered by the mouth, as this practice accounts for the majority of deaths under present-day treatment. The air treatment should be persevered with as long as any brain symptoms are present, and no case need be looked upon as incurable unless the animal becomes completely paralysed.

A cow having once suffered an attack of the disease is liable to another turn unless carefully dieted and exercised previous to calving. There is no doubt in my mind, and I have had experience of some thousands of cases of "milk fever," that if the calf were left with the cow for a few days after calving, or that, if it was taken away, the cow were never milked dry, but the action of the calf imitated, the number of cases would be largely reduced. However, the great preventive is the imitation of natural conditions, by avoiding over-feeding and the exercise of all deep milking susceptible animals.—CANTERBURY AGRICULTURAL COLLEGE MAGAZINE.

PROGRESS REPORT OF THE DRY ZONE EXPERIMENT STATION, ANURADHAPURA.

(From 15th October, 1915, to 15th December, 1915.)

The Acting Manager has made four visits since last report. The barbed wire fence has now been completed right round the 40 acres so that the cattle nuisance should now cease.

Three acres have been planted out 22 ft. 22½ ft. with oil-palms (Elæis guineensis) from the nursery in holes supplied with cattle manure. Germinated cow-peas have been intersown to improve the soil. These palms will be kept under irrigation throughout the dry season. Two plots have been planted with Gliricidia maculata cuttings for shade plots for coffee.

All the plots in the trial ground have been resown with the seed saved from the crops of last February but are not germinating at all well ; this is partly due to heavy rains and partly perhaps to loss of vitality in the originally imported seeds.

The only plots which are really doing well are those sown from the fresh seed sent from Peradeniya of red and pink dura and cow-peas, which are making a very luxuriant growth.

Six plants of Grape fruit raised in Peradeniya from seed have been added to the citrus plots. All plants have been well formed with cattle-manure.

The pines have been forked and manured with cattle-manure and ashes and look well.

The two grape vines have been pruned and are making good growth.

The sugar-cane plot has been cut and refilled up and manured for ratooning.

The betel vines have been cattle-manured and pruned, but are making very poor growth. The plot has been extended and Sesbania grandiflora sown as supports.

Two plots of cotton, Sea Island and Cambodia, have been sown.

The tobacco in the nurseries is germinating well.

All the plots reserved for tobacco have been sown with beans for ploughing in to improve the soil.

All drains have been considerably deepened, but even now many of the plots have suffered by flooding in the heavy rains, the resulting stagnant water killing the crops.

Owing to retrenchment, no more land will be levelled and stumped, so that after the tobacco crop has been established it will be possible considerably to reduce the coolies.

DUDLEY S. CORLETT,
Acting Manager,
Dry Zone Experiment Station.

RECORD OF PLOTS.

No. of Plot.	Date of Sowing and Planting.	Name of Crop.	Remarks.
2	23-10-15 ...	Vigna catiang ...	Medium
3	,, ...	Pigeon Pea ...	Half the stump dead
4-15	,, ...	Cow Pea ...	Good
16	,, ...	5 months dura ...	Medium

17	23-10-15	...	Dura white	...	Good
18	,,	...	Dura yellow	...	Medium
19	2-11-15	...	Sun flower	...	Good
20	23-10-15	...	Sorghum red	...	,,
21	,,	...	Sorghum white	...	Medium
26	2-11-15	...	Dura pink	...	Good
27	23-10-15	...	Maize red	...	Medium
28	,,	...	Maize golden yellow	...	Good
29-30		...	Sweet potato, old	...	Failure
31	3-11-15	...	Egyptian clover	...	Poor growth
32	4-12-15	...	Sea Island Cotton	...	Newly sown
33	,,	...	Cambodia Cotton	...	,,
39	2-11-15	...	Green gram	...	Good
40	,,	...	Green gram	...	,,
41	25-10-15	...	Haricot beans	.	Medium
42		...	Sugar cane	...	Ratoons growing
43		...	Algaroba beans	...	Good
44-45	10-11-15	...	Black gram	...	,,
46	5 11-15	...	New betel	...	Very poor
56		...	Sour sop and mulberry	...	Good
57		...	Guava	...	,,
58		...	Pine apple, Kew	...	,,
59		...	Pine apple, Mauritius	...	,,
60	15-9-15	...	Bananas	...	,,
64		...	Pomegranate	...	,,
71	3-12-15	...	Green gram	...	,,
72	8-11-15	...	Red dura	...	,,
73	9-11-15	...	Horse gram	...	,,
74	,,	...	Horse gram	...	,,
81	8-11-15	...	Polong me	...	,,
85	5-11-15	...	Pigeon pea	...	,,
87	29-10-15	...	Cow pea	...	,,
88	11-11-15	...	Penusetum kamber	...	Medium
89	27-10-15	...	Red dura	...	Good
90	5-11-15	...	Bandakka	...	Medium
91	4-11-15	...	Cluster beans	...	Good
92	27-10-15	...	Green gram	...	,,
93	5-11-15	...	Linseed	...	,,
95	25-10-15	...	Pannicum frumentaceum		,,
96	,,	...	Kurakkan	...	Medium
97	3-11-15	...	Sun hemp	...	Not good
98	,,	...	Pannicum miliare	...	Medium
99	26-10-15	...	Setaria Italica	...	Bad
100	,,	...	Black gram	...	Good
101	,,	...	Kurakkan	...	Medium
102	2-11-15	...	Jute	...	,,
103	5-11-15	...	Cow pea	...	Good
104	27-10-15	...	Vigna catiang	...	,,
105	,,	...	Polong me	...	,,
106	,,	...	Horse gram	...	,,
107	26-10-15	...	Voragan	...	,,
108	23-10-15	...	Sorghum	...	Bad
109	,,	...	Sorghum white	...	Medium
110	,,	...	Sorghum red	...	Good
111	25-10-15	...	Dura yellow	...	Medium
112	,,	...	Dura white	...	,,
113	,,	...	Dura	..	,,

THE NAMING OF PLANTS.

Precision was first given to the naming of plants by LINNEUS or VON LINNE, the great Swedish physician and botanist who lived in the eighteenth century. Based on sound principles, his binomial system of nomenclature persists in all essential particulars at the present day, and if employed with care and discretion, these binomial designations constitute perhaps the most scientific feature of biology. The names of plants as conceived by LINNEUS are of two kinds: those of the class and order which are *understood;* and those of the genus and species which are *expressed*. The name of the class and order never enters into the denomination of the plant, though at the same time it is always connoted. All plants agreeing in genus have the same generic name, and each generic name must be single; and further, two different genera cannot be designated by the same name. LINNEUS also laid down the rule that the best generic names are those which express the essential character or habit of a plant. In addition, he formulated other maxims concerning the etymological constitution of botanical names, limiting their construction to Latin and Greek: although many of these latter canons have been criticised as trivial and unimportant they are generally respected at the present day. In regard to the second or specific name, which is supposed to point out the particular species of each genus, we should again remember that those which indicate a decided specific character are the best. A good example of an intelligent specific name is found in *Panicum maximum*, where the generic name denotes the characteristic inflorescence of the genus, and the specific name the idea of size. To designate a variety, it should be mentioned that a third name preceded by the abbreviation 'var." is used after the second or specific name.

It is not unusual to use the name of a person as a specific name (spelt in the case of botanical, but not of zoological names, with a capital letter) in the possessive case, as *Thrinax Morrisii*, and in the case of all botanical and zoological names, the name (generally abbreviated) of the authority should be attached to them in order to avoid confusion in connexion with synonyms, thus *Saccharum officinarum*, L. This question of synonymy is a wide subject of the greatest importance in biology. We cannot in the space of this article presume to discuss it at any length, but one or two aspects may be referred to.

Amongst the flowering plants our present knowledge of systematy is sufficiently definite as regards genera for there to be little confusion possible in that connexion. But in the case of specific names it is otherwise, and it is quite common to find the same plant called by different names in different places by different botanists. For this reason the critical revision of genera is a very important branch of pure botany. The trouble lies principally in two directions. First, opinions differ as to what shall constitute a specific difference. Amongst systematic biologists we find two more or less distinct classes of observers who labour under the jocular but expressive names of 'lumpers' and 'splitters.' A 'lumper' is a botanist who shows a tendency to group closely allied forms under the same name, while a 'splitter' exhibits a tendency in the opposite direction, namely, to separate forms of close resemblance under different specific names. Either extreme is wrong, but in the light of modern biology, the tendency to excessive subdivision is perhaps the worse. The point is that a so-called species is not a fixed entity; species are constantly changing by slight mutations, or by acquired variations; and a specific name at best is but a provisional and temporary designation. The second reason for confusion in specific names lies in the circumstance that a describer may not be familiar with the work of others in different countries. This obstacle is being gradually overcome by increased facilities

as regards literature and the exchange of specimens ; but there still remains a need for more 'central clearing houses.' It should be remembered in the present connexion that the Royal Botanic Gardens, Kew, perform an important service of international influence in the matter of botanical nomenclature. The publication of the INDEX KEWENSIS has enormously reduced the confusion resulting from the existence of synonyms. The work goes on from year to year, and supplements of this remarkable index are issued at convenient intervals. In its pages the names which stand are printed in Roman type, while the synonyms appear in Italics. It is one of the indispensable works of systematic botany.

If we turn to the lower plants, especially the fungi, we find a much greater want of precision than amongst the flowering plants. The classification of the fungi is unfortunately artificial in many respects ; nor can this be wondered at, considering their comparatively simple structure. Morphological differences are often very minute and slender, and we not infrequently have to depend upon such varying factors as colour and shape as means of distinguishing genera and species. In the case of fungi which are not highly parasitic, it is possible to decide upon specific differences by means of comparable cultures. The genus Fusarium, for instance, is being studied after this manner in the United States. Different forms of the genus from all over the world are being grown in culture media under the same conditions, and it is hoped by means of the observations obtained to decide what forms are distinct and what are similar. It will be readily realized how important it is to eliminate synonyms amongst the fungi, by considering the case of Die-back disease of cacao. The fungus causing this disease has been known under at least half a dozen different names in different parts of the world and it was only after a critical examination of the forms in the Federated Malay States that BANCROFT came to the conclusion that they were all one and the same organism, which he named *Thyridaria tarda*. The practical importance of a result like this is considerable. The distribution of the fungus becomes definitely known, and legislation can be introduced accordingly. Further, methods of control formerly recommended as applying only to one form of fungus of supposedly limited distribution becomes afterwards applicable, at any rate theoretically, to half a dozen which were at first thought to be distinct.

Generally speaking workers on the fungi are inclined towards the class of 'splitters' previously referred to. There is a tendency to name new species on slender differences, and what is perhaps worse, to split up unduly established genera. Some evidence goes to show that this has been done for the sake of self-advertisement rather than in the interests of science. It is desirable that when they occur, such tamperings should be ruthlessly exposed.

Having discussed in outline the origin, uses, and some of the dangers attendant on scientific naming, we may profitably consider next the corresponding features of common or vernacular names. It is a mistake to think that common names of plants and animals are necessarily unscientific. Many conform to the canon of LINNEUS, which says that names should express the essential character or habit of the plant, and are accordingly highly instructive. Examples of this are very numerous : thus, nut grass *(Cyperus rotundus)* is so called because of the little tubers on the roots of this plant. On the other hand, the name nut grass is unscientific on account of the fact that the swellings are not nuts but tubers, while the plant is not botanically a grass but a sedge. Less open to criticism is the name soap-berry *(Sapindus saponaria)*, so called because the fruit of this plant will, when macerated in water, produce a lather like soap ; and again love vine (dodder) *Cuscula* sp., named after its habit of parasitic embrace ; and sea-side grape

(Cocco loba uvifera), so called on account of its maritime habitat and the superficial resemblance of the ripe fruit to purple grapes. But the common or vernacular name has many serious defects compared with the scientific designation. In the first place a popular name tells us nothing about the class or order to which the species belongs, that is to say, it gives us no clue whatsoever as to its position or status in the classification of the vegetable kingdom. Further, there is the more serious aspect from a practical point of view, that even in the same place a plant may be known by more than one common name. Thus *Bryophyllum calycinum* is known both as Wonder-of-the World and Love Bush; *Borrichia arborescens* as Sea-side Oxeye, Sea-side tansy, and Samphire; and the common *Vinca rosea* as Old maid or Periwinkle. When we come to consider the matter from an international point of view, it becomes even more obvious that scientific naming is essential. Thus in the case of the genus of fruit trees designated Anona, the same species is called by entirely different names in various parts of the world, and it would be hopeless to attempt to use a popular nomenclature in writing of this group. That such should be the case is almost a foregone conclusion on account of foreign languages. In the West Indies, even, we find that the admixture of French and English, and to some extent Spanish, leads to great confusion in regard to vernacular names. The desirability of using Latin and Greek for scientific names is not, as Linneus thought, because these are less barbarous than the modern languages, but because the dead languages are more fixed and international.

The subject of scientific and vernacular naming is a wide one, but it is believed that in the foregoing we have referred to most of its principal aspects. It will be realized that if employed at all, it is essential to use scientific names intelligently, and with due regard to synonymy and the vernacular. Very frequently the common name is a quicker and better means of indicating a species than the scientific, though as a general rule it may be laid down that it is safer and more scientific to use both kinds of names. In this connexion we would call the attention of writers in the East to the fact that the employment of the Indian vernacular without the scientific, or at least the English equivalent, very often makes their literature quite unintelligible in other countries, which is a pity on account of the high standard and general interest of much of the Indian work. No reference has been made in this article to the pronunciation of scientific names as this is a matter which lies somewhat outside the present subject. If the continental system is unfamiliar to him, the beginner will do well to pronounce Latin in the same way as we should English, in giving the same value to the vowels. Accentuation and some of the consonants occasion a certain amount of difficulty, but very slight attention to the marks and directions to be found in many botany books will lead anyone to a correct pronunciation. It is hardly necessary to point out that a knowledge of the classical languages themselves is of great use in connexion with scientific names, and may be regarded as essential to those botanists and zoologists who are engaged in the study of systematy.—The Agricultural News.

PROGRESS REPORT OF THE EXPERIMENT STATION, MAHAILUPPALAMA.

(From 15th October, 1915, to 15th December, 1915.)

The 7th picking was done on 16th October, 1915. The number of nuts collected was 4,066 from 524 trees, an average of 6·48 per bearing tree or 2·43 per acre tree.

This gives a total of 19,105 for the year 1915 to date from an area of 23½ acres composed of Plot A 17 acres of 7 year old trees and Plot B 6½ acres of 8 year old trees (number of trees per acre 70).

In the irrigable area (7 year old trees) consisting of 1,224 trees, 464 trees gave 3,804 nuts, an average of 8·2 nuts per bearing tree.

The unirrigable area (8 year old trees) consisting of 60 trees, gave 262 nuts, an average of 4·36 nuts per bearing tree.

The eighth picking was done on 10th December, 1915. The number of nuts collected was 3,435 from 438 trees, an average of 7·8 nuts per bearing tree or 2·05 per acre tree. This gives a total of 22,540 nuts for the year 1915 to date from an area of 23½ acres composed of Plot A 17 acres of 7 year old trees (number of trees per acre 70).

In the irrigable area (7 year old trees) consisting of 1,224 trees, 402 trees gave 3,081 nuts, an average of 7·66 nuts per bearing tree.

The unirrigable area (8 year old trees) consisting of 36 trees gave 354 nuts, an average of 9·83 nuts per bearing tree.

The following figures have been obtained with regard to copra production :—

COMBINED PLOTS.

Picking.	Break nuts.	Rejections.	Copra lb.	No. of nuts per candy.
Sept.-Oct. ...	4,066 ...	½ % ...	1,904 ...	1,190
Sept.-Oct. ...	3,259 ...	Plot A ½ % ...	1,789 ...	1,015
Sept.-Oct. ...	251 ...	Plot B 0 ...	115 ...	1,222

A consignment of copra, 1,699 lb., was sent to Colombo and sold on 3rd December, 1915, fetching Rs. 84·25 per candy which was the highest obtained.

DUDLEY S. CORLETT,

Acting Manager,

Experiment Station, Mahailuppalama.

CHLOROSIS IN PLANTS.

The preceding researches of the writer have shown that chlorosis can be produced experimentally in maize (*Zea mays*) by depriving the plant of sulphur or of iron ; the omission of manganese from the nutritive solution produces a partial decoloration of the leaves.

The first disease quickly disappears on providing the plant with the missing element, by applying it in the form of a very dilute solution to the blade of the discoloured leaf. The second disease does not yield to the action of manganese applied in the same manner ; but one drop of liquid exuded from the leaves of healthy plants will give the discoloured parenchyma a bright green colour in sunlight. Thus the liquid exuded by healthy plants contains an organic substance which cures diseased cells.

The active substance is specific : the exudations of cabbage, poppy and millet have no effect on this form of chlorosis in maize.

Thus, it is clear, there are several kinds of chlorosis which are distinguished from one another by their determining cause and by the treatment which causes their disappearance.

The most common form is due to lack of iron. This element, however, is very plentiful in the different kinds of arable soil. But limestone locks it up and hinders its absorption by a great many species of plants by alkalizing the excretions of their roots.

The carbonates of the alkaline earths without exception provoke chlorosis in plants susceptible to it. But it often happens that refractory species become chlorotic even in soils poor in lime. These anomalies form the subject of this article.

Transplanting may determine them: this operation destroys a large number of the fine rootlets bearing the absorbent hairs. Now, it is just these hairs which also constitute the excretory organs of roots and which render soluble the mineral elements necessary to the plant. Transplanting thus deprives the plant of certain indispensable substances, and especially of iron. This can easily be proved by placing upon chlorotic leaves a nitrogenous solution of iron of 1/2000. But the leaves become green again of their own accord as soon as the network of rootlets has reformed. Copious watering with a view to bringing about the recovery of the leaves only makes matters worse, since thereby, if the soil is rich in lime, the complete precipitation of the iron and its absorption by the calcium carbonate is brought about as the soil regains its usual amount of humidity; if the chlorosis persists, gardeners cure it successfully with a solution of sulphate of iron.

Cryptogamic diseases also promote chlorosis, even where the roots remain intact. Fungi are in fact active destroyers of organic acids; if the acidity of the descending sap is diminished, the excretions of the refractory plants become alkaline and their roots incapable of dissolving oxide of iron. The writer has observed the occurrence of chlorosis on maize plants cultivated in an aseptic solution each time that the culm was attacked by fungi, and especially by *Penicillium glaucum*. The decoloration of the leaves is sometimes complete. When the surrounding temperature rises above 30° C. (86° F.), the chlorosis disappears of itself, for high temperatures hinder the growth of the fungus and promote that of the maize.

Alkaline carbonates act in the same manner as the carbonates of the alkaline-earths, but more energetically.

Maize is refractory to the action of limestone; it becomes chlorotic in solutions rendered slightly alkaline by the addition of potash or soda.

Plant ash is very rich in alkaline carbonates and forms an excellent manure, but if it is applied in too large quantities it gives rise to chlorosis and often causes the death of the plants.

The alkalinity of the soil plays a large part in the absorption of iron by plants. The same may be said for manganese. Under natural conditions it is always the want of iron that makes itself felt, since plants require more iron than manganese.

The chlorosis observed by the writer on depriving the maize of manganese is, further, of a special kind. He has succeeded in reproducing it in plants of maize supplied with a complete nutritive mineral solution by exposing them to insufficient light. Out of ten clearly etiolated plants, three showed symptoms of chlorosis identical with that caused by the use of a solution lacking manganese. This disease is thus a characteristic of a pathological condition apparently due to various causes.

The special action of the exudation of healthy plants upon diseased individuals shows that plant cells, like the glands of certain animals, produce substances possessing special physiological properties.—BULL. OF FOR. AGRIC. INTELLIGENCE.

MEASUREMENT OF CATTLE FOR WEIGHT.

To arrive at a close estimate of the weight of cattle, mere guesswork is not reliable. There is, however, a rule by which the weight can be very accurately determined. There is one condition in connection with this method, which cannot easily be adapted to the guessing competition of the fat bullock, say, at the National Association's Exhibition at Bowen Park. That condition is that the competitor must be able to handle the beast, and this, of course, cannot be permitted, where the weight has to be arrived at by merely studying the build and condition of the animal

THE RULE IS—

Multiply the square of the girth by 5 times the length. Divide the product by 21. This gives the net weight of the animal in imperial stones of 14 lb. Or, to obtain the weight in scores, divide by 30.

EXAMPLE.

An animal girths 7 ft., and is $5\frac{1}{2}$ ft. in length.

The square of the girth is $7 \times 7 = 49$; 5 times the length is $27\frac{1}{2}$. Then $49 \times 27\frac{1}{2} = 1,347\frac{1}{2}$.

Divide this by 21. Result: 64 stones 2 lb., or 898 lb. Or, dividing by 30. Result: 44 scores 18 lb., or 898 lb.

If the animal is very fat, $\frac{1}{15}$ should be added to the weight thus obtained; if not moderately fat, $\frac{1}{15}$ should be deducted.—QUEENSLAND AGRICULTURAL JOURNAL.

THE CULTIVATION OF TEOSINTE *(EUCHLAENA LUXURIANS.)*

D. J. G. VAN SETTEN.

Experiments at Moeara-Enim (South Sumatra) have shown that sowing without transplanting is the best method of cultivating this forage plant. One hoeing is then sufficient as interculture. The distance between the plants should be 20 to 30 inches. About one month after sowing the first cut can be made, and subsequent cuts can be effected regularly every month until six crops have been obtained. The total yield of green stuff was 13 tons per acre while the expenses amounted to about 3*s.* 9*d.* per ton.

For feeding, the daily ration was 80 lb. per head. This forage plant is recommended as a cattle feed on account of its high content of protein (10·6 per cent.) and carbohydrates (43·7 per cent.)—BULL. INT. INST. OF AGRIC.

NOTE ON OXALIS VIOLACEÆ (*MANICKWATTE WEED.*)

This weed has been established on many estates in different districts for several years, and as the question was often raised as to its harmfulness to tea, the amount of growth and the nitrogen and mineral constituents removed temporarily from the soil were investigated.

A fairly thick growth of Oxalis 5" to 6" high was dug up with all bulbs from a measured area in tea of 41 square feet. The material was thoroughly washed free of soil and weighed 4·3 lb. It was then sun-dried, losing 63·1 per cent. as moisture. The sun-dried material was analysed for organic matter, nitrogen and ash constituents, the result being given below.

ANALYSIS OF (SUNDRIED) OXALIS VIOLACEÆ.

Composition per cent.			lb. per acre.
Moisture	21·0 per cent		—
*Organic matter	71·5 ,, ,,		1,200 lb. per acre
+ Mineral matter	7·5 ,, ,,		126 ,, ,, ,,
	100·0		
+ Containing nitrogen		1·36 per cent.	22·9 lb. per acre
*Containing Lime		9·70 ,, ,,	11·9 ,, ,,
,, Magnesia		4·00 ,, ,,	5·0 ,, ,,
,, Potash		11·80 ,, ,,	13·8 ,, ,,
,, Phosphoric acid		9·60 ,, ,,	11·8 ,, ,,
,, Sulphuric acid		3·40 ,, ,,	3·7 ,, ,,

The Oxalis plant at the above thickness of growth supplies over half a ton of organic matter derived from the air and gives back to the soil when it dies back in dry weather the above quantities of nitrogen and ash constituents in an easily available form. As the above amount of growth is only a matter of a few weeks in favourable weather, the amount of organic matter returned to the soil annually if the ground is cleaned 3 or 4 times a year must be considerable and would result in a gradual increase of the valuable humus which is so important in the soils of Ceylon and most tropical countries.

It is evident that it temporarily removes some of the phosphoric acid and potash of the soil or the manures applied, but at the same time it prevents loss by drainage and returns the mineral matter in a form which is easily attacked and utilised by the roots of the tea. Although it is unsightly from an agricultural point of view and should be eradicated as soon as it first appears on an estate, evidence goes to prove that if it is established, it is better left alone, (all other weeds being removed), as the tea if properly manured does not fall off in yield. Scraping the soil as is commonly done is not only expensive, but increases the thickness of the subsequent growth; while if not touched, the plant dies down and disappears entirely at the beginning of the dry season, appearing again with the wet weather.

M. KELWAY BAMBER.

CEYLON WEATHER IN 1914.

There is a marked variation in climate between the different parts of Ceylon. In the low-country, with a mean temperature of the order of 80°F., a noticeable feature is the small range of both temperature and pressure; there is, however, wide divergence between the moist conditions in the south-west of the Island, where the average annual rainfall varies from 100 to 200 inches, and the dryzone areas of the north, north-west, and south-east.

Inland, with altitudes reaching 8,000 feet, the temperature is cooler and shows a bigger range; there is a corresponding change in vegetation, and the conditions are altogether more akin to those in the temperate zone.

RAINFALL.

The highest annual rainfall registered was at "St. Martin's Estate," Rangalla, which had a total of 178·93 inches, and 174 days on which rain fell. The lowest annual rainfall was at Mankulam, which had a total less than half its average, i.e. 26·01 inches in 90 days. The stations with the highest and lowest average annual rainfall are respectively Padupola, with 220·73 inches in 202 days, and Marichchikade, with 33·06 inches in 57 days. The longest drought occurred at Mantota, lasting for 143 days, May 9—September 28. The longest wet period occurred at "Duckwari Estate," Rangalla, lasting for 62 days, May 27—July 27.

The annual rainfall at Colombo (Cinnamon Gardens) was 74·26 inches in 181 days. At Kandy 78·90 inches were registered in 197 days, while the annual rainfall at Nuwara Eliya was 83·95 inches in 220 days. On the whole the annual rainfall was above normal in the north and east, and slightly below it elsewhere.

TEMPERATURE.

The highest average for the year was at Trincomalee 83·8°F., and the lowest Nuwara Eliya 60·4°F. At Colombo and Kandy the averages were 81·1°F. and 76·7°F. respectively.

The highest shade temperature recorded during the year was 101·2°F. at Anuradhapura on September 17. The highest on record is 103·7°F. at Trincomalee on May 12, 1890.

The highest shade temperature at Colombo in 1914 was 93·1°F. on February 10.

The mean daily range, i.e., difference between average maximum and average minimum, was highest at Nuwara Eliya (19·1°F.) and lowest at Galle (9·4°F.). At Colombo and Kandy it was 12·8°F. and 14·2°F. respectively. The absolute range, i.e., difference between actual highest and lowest readings, for the year was maximum at Nuwara Eliya (51·2°F.) and minimum at Galle (21·1°F.).—REPT. ON THE COLOMBO OBSERVATORY FOR 1914.

STUDIES ON DROUGHT IN RUSSIA.

One of the most important subjects of the work of the Odessa Experiment Station is the thorough study of drought and of the measures taken against it. In the study of the root system of cultivated plants, very interesting results have been obtained, especially as regards the method used for producing a full complement of roots. In the experimental field more than 40,000 determinations of soil humidity have been made, with a view to studying the circulation of water in the soil under different cultural conditions. The nature of drought, its causes, and the methods for dealing with it would seem to be as follows :—

Nature and causes of drought. (2) The depths attained by the root systems are from 27½ to 28½ inches in the case of potatoes, flax and some other plants, from 3 feet 3 inches to 3 feet 10 inches for most Gramineæ, 4 feet 10½ inches for sunflowers and mangels, and more for lucerne and other perennials.

(2) In order to ensure an abundant crop, the layer of soil containing the roots must be moist throughout its depth.

(3) The chief causes of the phenomenon of drought are : (a) the fact that towards the date of the spring sowings only a portion of the root-containing layer (at a depth of 1 foot 3 inches to 1 foot 7½ inches) contains

moisture—this is the general rule when a succession of grain crops is cultivated and with summer wheats with a fallow every third year. This lack of humidity in the soil is due to the fact that with cereals usually all the available water of the soil is already consumed towards the end of the growing period ; this consumption is completed by the weeds which appear after the harvest, with the result that the depth of the moist layer in the spring depends exclusively upon the autumn, winter and spring rainfall, which is often quite insufficient ; (b) the chronic lack of moisture over many years of the intermediate dry stratum of the soil lying beneath the upper and periodically wetted layer, and, as a result of this drying, the absence in that stratum of chemical processes transforming the insoluble mineral substances ; (c) the great depth at which the lower, constantly wet stratum is situated, which results in the intermediate dry layer of the soil becoming especially thick.

Measures for combating drought. (1) The working (scarifying) of the stubble-covered surface as soon as the wheat is got in with a view to the greater accumulation and saving of the humidity derived by the soil from the late rains.

(2) The extermination of weeds ;

(3) The forming of the black fallow, by means of which the intermediate dry layer of soil is moistened and disappears, or rather gives rise to a continuous damp stratum.

(4) A regular system of rotation founded, not only on the alternation of the crops themselves but also on the root systems (greater or less depth tapped etc.). This prevents the continued drying of the stratum containing the roots ; some plants requiring the use of a cultivator, such as potatoes, flax, pumpkins, etc., do not use all the water available in the stratum occupied by the roots and therefore accumulate moisture for the following year.—Bull. Int. Inst. of Agric.

HOW YAMS MAY BE GROWN.

W. G. TAYLOR.

I have been asked to give an account of how I plant yams and make such a success of it, and I do so not because I have superior knowledge to the hundreds of other growers in Hanover, but because I know that there are many who would do better if they had the experience of others like myself who have, through failure and losses and successes arrived at methods that stand us in good stead.

To begin with I own the lands I cultivate and it might interest your readers to know that I did not inherit them but bought them out of the proceeds of cultivation, chiefly yam growing.

My lands are old cow pastures in which I run a few head of cattle and mules which I find very useful helps to my field, by way of supplying manure and firming the land and also making use of the weeds and grasses that grow up. By their use an old thrown up yam field converted into a pasture is ready to be replanted in from two to three years.

In taking up a piece of pasture for planting Lucea yams, I have the grass weeded and the hills dug in November and December. Forking is a new operation here and I have just begun with it, and I suppose from what the Instructor tells me I will get better results; that is left to be seen.

I do not dig two thousand hills to the acre as is done on rent lands, I consider that a "greedy choke puppy" policy to pursue. I find that 1,500 and even 1,200 hills are quite sufficient for an acre.

I make sure that my hills are well dug, deep and large, and that the place is well drained to prevent my yam hills being washed by heavy rains. The preparing of heads for planting is a very important part of the business. A head should be 4 lb. at least in weight, and in any case not much smaller, so that it may grow a vigorous and healthy sprout One in each hill is sufficient. When on account of scarcity of heads smaller ones have to be planted, two can be put to the hill.

Some yam growers believe in planting deep, but I find I get better results by shallow planting, so that portion of the head is exposed. The reason I think is, that when weeders are put to work they mould up the hills and cover the heads entirely, if they were planted deep, they will then become too deep and the result would be a poor crop.

A yam field should be weeded often enough to keep the ground free of weeds while the yam is growing and this might mean one, two or three weedings, according to soil and weather.

Now quite a good many planters cut their yams before they are ripe so that they may take advantage of a temporary good market or so that they may get large heads. By doing this a head may be not large enough to plant 4 hills. This is quite good enough for a man who is trying to increase his stock of heads, or for a beginner, but I plant yams that I may get food for myself and plenty to sell, and I want as good a yam as I can get. I allow the yams to ripen and then "slip" or "back" them, that is, I cut the yams and turn them in the hills without taking them out. They will keep thus for a long time if they are ripe and will be very good for eating. They will not make large heads, but they will make heads large enough to plant one or two hills each. In all kinds of yams I plant about 10,000 hills each year, which is not very large for a Hanover yam grower.

Good yams, that are well matured, will always be preferred in any market and I find no difficulty in selling mine to the exclusion of loads of unripe yams.

In conclusion I will tell your readers that I have always tried to follow the hints I get from the Journal and have found many of them very useful.—
JAMAICA AGRICULTURAL SOCIETY JOURNAL.

HOW THE BARK BREATHES.

Like all other living things, plants must breathe or they will not continue to live. The more highly specialised among them are therefore provided with elaborate respiratory systems, consisting of passages which conduct air to all parts of the plant, and openings on the surface, through which oxygen can be taken in and carbon dioxide given out, substantially as is the case with animals.

The external openings of this ventilating system are of three general types : stomata or valves on the surfaces of leaves and young shoots ; ventilating pores, which occur in certain ærial roots ; and lenticels, pores in the older wood, whose presence can be noted by the unaided eye in almost any plant.

The earlier naturalists were quite in the dark as to the function of these pores, GUETTARD, who described them in 1745, designated them merely as

glands ; DE CANDOLLE (1826) thought they were a kind of bud, from which roots later put forth ; UNGER (1838) believed they had something to do with reproduction ; but as early as 1809, DUPETIT-THOUARS declared their purpose was ventilation, and the work of several students during the next half century demonstrated that this opinion was well founded.

Although he misunderstood their purpose, DE CANDOLLE gave them the name which they now bear, because of the resemblance of one of these pores to a minute, bi-convex lens, in general shape.

They are usually found on both stem and root of a plant, but may also appear on leaf-stems, and sometimes on fruits—the walnut and horse-chestnut, for instance.

Yet, in spite of their widespread distribution, they have been sought in vain on some plants. They appear not to exist on the European grape *(Vitis vinifera)*, although they can easily be seen on its close relative, the Scuppernong grape of the southern United States *(Vitis rotundifolia)* ; they have been not discovered on the Italian honeysuckle, the trumpet creeper *Tecoma* radi cans, some species of Clematis, the Philadelphus or mock-orange, Deutzia, *Rubus odoratus*, etc.

It has been explained that these plants are provided with a regularly repeated annular formation of the bark, and therefore do not stand in such need of lenticels for the purpose of ventilation. But this hypothesis carries little weight, when one finds that other plants with similar bark have lenticels. Why, for instance, should the climbing honeysuckles lack these organs, while those which do not climb possess them ? And why are they present in the bittersweet *(Solanum dulcamara)*, the Boston Ivy (*Ampelopsis*) the Wistariar, and other plants which have habits of growth and formation of bark similar to those above referred to, which lack lenticels.

Another difficulty in the way of believing the idea once held, that they are indispensable to the respiration of the plant, is the fact that during a considerable part of the year they are partly or wholly closed by the formation of a layer of cork underneath them. This is particularly the case in winter, the plant's resting period, when little ventilation is necessary ; but observers have found that this closing of the ventilators often begins in early summer, so that spring is the only season when the lenticels are functioning.

Further, it has been discovered that the lenticels are in some cases permanently closed ; they look normal from the outside, but are in reality of no value whatever to the plant for breathing.

These facts have led many plant physiologists to think that although the lenticels undoubtedly do fulfil in many cases the function of breathing pores for the bark, that is not really their purpose. Such a solution of the problem accords well with the interpretation of nature of certain scientists, who hold on philosophical grounds that nothing should be said really to have a purpose.

EXPERIMENTAL TESTS.

But whether breathing is the purpose of the lenticel or not, one can very easily demonstrate that it actually does act in most cases as an outlet for the plant's ventilating system. A favourite laboratory experiment is to seal up one end of a stick, seal a tube around the other end, and then force air under pressure through the stick, submerged in water. A string of fine bubbles will issue from every lenticel. The fact can be demonstrated even more easily, merely by sealing both ends of a short stick and then submerging it in warm water ; the warmth will in most cases be sufficient to expel the cooler air within the stick, and bubbles will appear at the lenticels.

Sometimes these openings reach a length as great as a third of an inch ; in other cases, as in the bark of the sycamore (*Platanus*), they are so small as

to be almost microscopic. In twigs they are commonest on the under side, and the number increases somewhat regularly with the age of the wood. On a piece of elm branch 20 centimetres long, HABERLANDT found the number of lenticels as follows :—

	First Year.	Third to fifth year.	Tenth to fifteenth year.
Upper side ...	55	66	95
Under side ...	70	78	96

The lenticels usually begin formation under the surface, frequently beneath one of the stomata, in which case, as the epidermis is gradually replaced by cork (i.e. bark), the lenticels take the place of the stomata as ventilating pores.

Structurally, the lenticel may be described in simplest terms as an opening through the bark which is filled, in most cases, with a mass of powdery packing-cells, so loosely arranged that air can easily pass between them. In wet weather these cells usually expand and protrude from the opening, so that the lenticel comes to resemble a wart.

This response to the humidity of the outside air gives the clue to another function which the lenticels share with the stomata—to aid in regulating the transpiration of the plant. Indeed, DEVAUX, one of the latest botanists to give the subject careful study, concludes that it is more correct to say they regulate the amount of moisture in the plant than to ascribe ventilation as their chief function.—JOURNAL OF HEREDITY.

VALUING AGRICULTURAL ESTATES AND LANDS.

The first step to be taken in assessing an agricultural estate on the basis of its capitalisation value is to determine the precise gross return from the estate. For this purpose a question form is employed which takes into account the details of the estate and thus enables the assessor to obtain an exact knowledge of the concern of which he has to determine the average gross returns for the last 5 to 10 years. Such returns will be also realizable in the future as they correspond to the general average of the region. The writer reproduces the question form employed for this purpose by the Swiss Peasants' Secretariat.

The second step consists in the choice of the coefficient for the determination of the capitalization value from the table of these coefficients, taking into account the type of farming, the orientation of the production and the size of the concern to be valued.

This coefficient may be liable to small variations if the estate in question, owing to certain peculiarities, cannot be placed under any of the established heads in the table. On multiplying the gross income by the factor for the capitalisation value, the average capitalisation value of the estate is obtained (land-capital, building-capital, improvement-capital, cultivation-capital) the product of the combination of all the factors of production taking part in the agricultural concern and employed in accordance with local methods.

To determine the capitalisation value of the land itself, it is necessary to deduct from the agricultural revenue the returns from the buildings. For dwelling houses one takes into account the capitalisation value (the capitalised difference between rent and outlay, plus the value of building material after demolition); for farm buildings, the value of construction is considered,

and both are determined in relation to the economical value of the buildings. For the determination of the capitalisation value of each particular lot of ground, 3 different methods may be employed : the method based on the commercial value, the natural method, and the combined method. The method based on the commercial value establishes the comparison between the capitalisation value and the commercial value of the estate as a whole, and with the help of this comparison and of the known commercial value of the lot in question, the capitalisation value of this lot is determined. The natural process starts from the average capitalisation value per acre of the estate, from which the estimate of the lot in question is established according to its natural and economic conditions ; this is done with greater exactitude by the aid of a system of points devised by Prof. Laur, that is the number of points to be assigned is reckoned either according to the object of the assessment, or according to the average conditions of the agricultural property in question, or the average and customary conditions of the region. The combined method (a combination of the two previous methods) first of all establishes the numerical ratio between the average capitalisation value per acre of the estate and its average commercial value per acre. Then it determines the average commercial value per acre of the lots belonging to the group of fields which include the lot to be valued. By aid of this latter value is then calculated, according to the method based on the commercial value, the average capitalisation value per acre of the land in this group of fields, which serves in its turn as the point of departure for valuing by the natural process the particular lot in question. Applying the point system one then compares, in the first place, the lot of ground to be valued with the average of all the lots belonging to the group of fields in question.

The capitalisation value of the bare land of an agricultural estate can be obtained by deducting from the total capitalisation value of the estate the building-capital plus the cultivation-capital ; it may, however, be directly calculated by the aid of the coefficients of the capitalisation value of the soil established *ad hoc* by the Swiss Peasants' Secretariat ; coefficients which represent the relation between the capitalisation value of the soil and the gross revenue from the estate. To determine the capitalisation value of the bare land of each particular lot, the method based on the commercial value and the combined method based on the point system may here be employed with advantage. If the capitalisation value of entire communes is to be estimated, one must first, as previously, determine the total gross revenue of the commune, then choose the average coefficient of capitalisation value, taking into account the average conditions obtaining in the commune as regards the type of farming, the trend of production, and the size of estates ; multiplying the gross revenue by this average coefficient, the capitalisation value of the entire commune is obtained. In order to calculate by the aid of this value, the capitalisation value of each particular lot, one may, as before, employ 3 methods. As general rule the method based on the commercial value may be employed ; the natural method is particularly advisable when the estates are isolated and have clearly defined boundaries, whilst the combined method is best employed when the buildings are clustered into villages, and where the demesne is much scattered. Likewise, the capitalisation value of the bare land of an entire commune can be calculated directly with the aid of an average coefficient of the soil's capitalisation value.—

Bull. Int. Inst. of Agric.

THE PREVENTION OF SOIL WASH.

The greatest waste in Jamaica—among many forms—is what few think of, and we do not suppose people in towns ever give it a thought. It is the washing of soil, of good land, into the rivers and gullies and then into the sea.

People will quarrel and go to court over an inch of land along their lines or boundaries, and yet view with equanimity the heavy rains washing away inches deep of soil from the surface of their land, wherever it is bare and not drained.

After the recent heavy rains we noticed on some hillside cultivations, not trenched, little gullies all over, some plants washed bare or washed out, and at the foot of the hill large banks of soft soil which had been washed down: tons of good earth had probably already been washed into stream; then the rains stopped and left the big bank of good earth on the bank of the stream; an hour or two more of heavy rains and this would have gone, to be replaced by another bank of soil washed down.

Land costs money; at this particular place the land cost small settlers £5 per acre. There were acres of it, and that the best of it being washed away during the heavy rains.

We saw another piece of land very steep, but thoroughly trenched; every chain had a 2 ft. deep trench across the hillside; every trench was nearly up to the top with soft soil washed into it, but there was no more in the bottom trenches than in the top ones; there was no bank of earth heaped up at the foot of the hill, practically none had been washed away.

When the rain was over the trenches would be cleaned out and the nice earth flung—not on the edges of the trenches—but all over the land.

The owner of this particular land had unfortunately just cleaned out his bananas in order to give them a last forking for the season, and he had failed to leave the weedings in a long line between the rows which also would have helped to prevent the wash; the weeds were in scattered heaps.

Such rains (of August and September) were, of course, unexpected. It is good to have the land covered when the heavy seasons rains ought to come. Green cover crops are a help in this way. In heavily shaded places bananas, with cocoa or coffee on, however, cowpeas and other crops for green dressings will not grow in heavy shade; we have not yet found one legume that will start in the shade, although some will grow in the shade of bananas if started when these are young and open. In such cases (hillsides), the weedings should rather be kept in long lines, rather than as is commonly done, in heaps.

Trenches or drains should be put in across every cultivated hillside, no matter the kind of cultivation.

TERRACING.

On steep hillsides, the terrace or platform system of working can be adopted with very great advantage. Thus the cultivator can work his field with greater facility and less exertion, as the outside of every platform or terrace is a foot-path so that he does not need to hand on to the hillside in going up and down, but walk easily along; the plants instead of having their roots exposed on the lower side when they are only growing with half a root system—as is usually the case with bananas, and partially the case with cocoa, less so with coffee but still to some extent—are growing on a flat; no trenches are required, the terrace does the drainage and catches all the wash; the terrace should always be tilted towards the hill not sloped with the hill; the washings can easily be cleared off and spread on the land.

The beginning of this system is sometimes noticed in the cultivation of yams on hillsides. Each yam is on a square platform or terrace; this platform should, however, be carried right along the hill, the yam hills being placed close in the line and wider between the rows. For bananas this is, we feel, the system for steep hillsides; the cocoa or coffee can then be planted very easily towards the inside of the platform against the hill. It is easy clearing off the earth after heavy rains from around the cocoa and widening the terrace if required.

This is not in any way a "discovery." It is not our idea. We read years ago of the wonderful terracing system on the mountain-sides in lands peopled by what we call "ancients," that is people who cultivated (a great deal better than we do now), thousands of years ago. Not only that, but these "ancients" had the most wonderful irrigation systems and irrigated the driest and most arid hillsides.

In Italy at the present day the lime and orange trees are grown on terraces along rocky hillsides.

In the Canary Islands the "Dwarf" bananas that are so much exported to the United Kingdom are grown on terraced hillsides which are irrigated. We have had this idea in mind for Jamaica for years and have spoken about it for years but have not had it thoroughly tested; indeed only have seen the plan carried out in a "sort of way."

It is a plan, however, that is now written about for the purpose of criticism before anyone adopts it.—JAMAICA AGRIC. SOC. JOURNAL.

SUGGESTIONS FOR CURING COCOA.

The following suggestions for curing cacao and obtaining nice round beans with fine aroma and good break are given as an appendix to the Report of the Trinidad Cacao Commission.

When the pods are broken in the fields the entire contents, including the placenta or guts, must be taken to the curing house and put to sweat along with the cacao, and only removed when the cacao is put into the drying houses. The sweating ought to be from 3 to 4 days in the box, then turned over into another for two days before being turned out into the drying houses. Of course, when drying space is required, sweating for shorter periods may become necessary.

When the cacao is in the sweating boxes it ought to be well covered up with banana leaves at each sweating, and these leaves ought not to be thrown away, but used over and over again along with fresh leaves as the curing of the crop progresses and only be turned into manure when the crop is finished. Removable covers to the sweating boxes cause quicker fermentation. The placenta or guts make a splendid manure, and ought to be put in the manure heap and used when planting out supplies of cacao, cedar or any other trees, as it makes them grow rapidly. Placenta when thoroughly dried is saleable and would pay to export could it be pressed into bales so as to economise in freight and cost of bagging. The foregoing suggestions will undoubtedly assist in improving the quality of the cacao cured, but, of course, in rainy weather discretion must be used as to the period of sweating as on no account must black cacao be turned out. Claying cacao ought to be avoided as much as possible, and when necessary only sufficient to give a uniform colour ought to be used.—JAMAICA AGRIC. SOC. JOURNAL.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Socotrine cwt.	Fair to fine	40/ a 50/
Zanzibar & Hepatic ,,	Common to good	40/ a 70/
ARROWROOT (Natal) lb.	Fair to fine	5d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£7 10/ a £7 15/
East Indian, bleached ,,	Fair to good	£8 10/a £8 12/6
,, unbleached ,,	Dark to good genuine	£6 5/ a £7
Madagascar ,,	Dark to good palish	£7 15/ a £8 2/6
CAMPHOR, Japan lb.	Refined	1/7 a 1/8
China cwt.	Fair average quality	155/
CARDAMOMS, Tuticorin	Good to fine bold	5/9 a 6/
per lb.	Middling lean	4/8 a 5/4
Malabar, Tellicherry ,,	Good to fine bold	5/9 a 6/3
Calicut ,,	Brownish	3/9 a 5/3
Mangalore ,,	Med Brown to good bold	4/ a 6/4
Ceylon, Mysore ,,	Small fair to fine plump	4/ a 6/4
Malabar ,,	Fair to good	3/2 a 3/4
Seeds, E. I. & Ceylon ,,	Fair to good	4/ a 4/3
Ceylon "Long Wild" ,,	Shelly to good	2/3 a 3/6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	50/ a 60/
Japan ,,	Fair bright small	60/ a 70/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜d a 7d
Ceylon	Org. Stem	2d a 6d
	Red Org Stem	1¾d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts.	Good to fine quill	1/3 a 1/9
per lb. 2nds.	,, ,,	1/2 a 1/7
3rds.	,, ,,	1/1 a 1/6
4ths.	,, ,,	1/ a 1/3
Chips.	Fair to fine bold	2d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	1/ a 1/2
Amboyna ,,	Dull to fine	10d a 10½d
Zanzibar ,,	Fair and fine bright	5⅝d a 6¼d
Madagascar ,,	Fair	7d
Stems ,,	Fair	2d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	63/ a 80/
COCOA, Ceylon Plant. ,,	Special Marks	81/ a 88/6
	Red to good	73/ a 80/6
Native Estate ,,	Ordinary to red	42/ a 68/
Java and Celebes ,,	Small to good red	30s a 93s
COLOMBO ROOT ,,	Middling to good	15/ a 22/6
CROTON SEEDS, sifted,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	130/ a 150/
GINGER, Bengal, rough ,,	Fair	19/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	35/ a 74/
Cochin, Rough ,,	Common to fine bold	22/6 a 27/
	Small and D's	20/
Japan ,,	Unsplit	20/
GUM AMMONIACUM ..	Ord. Blocky to fair clean	40/s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
	,, ,, red	£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	26/ a 32/6
Turkey sorts ,,	,, ,,	37/ a 57/6
Ghatti ,,	Sorts to fine pale	17/ a 27/
Kurrachee ,,	Reddish to good pale	22/6 a 32/6 nom.
Madras ,,	Dark to good pale	20/ a 30/ nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£6 a £6 10/
	com. stony to good block	40s a £5
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	57/6 a 67/6
Somali ,,	,, ,,	52s 6d a 55s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	35s a 40s
pickings ,,	Low to good pale	15/ a 27/6
siftings ,,	Slightly foul to fine	18s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	2/4
Ceylon, Straits, ,,	Crepe ordinary to fine	2/2¼
Malay Straits, etc. ,,	Fine Block	2/4¾
	Scrap fair to fine	1/8 a 1/9
Assam ,,	Plantation	1/10
,,	Fair II to ord. red No. 1.	1/3 a 1/6
Rangoon ,,	,, ,, ,,	1/2 a 1/4

	QUALITY.	QUOTATION
INDIA RUBBER lb.		
Borneo ,,	Common to good	9d a 1/3
Java ,,	Good to fine red	1/3 a 1/6
Penang ,,	Low white to prime red	9d a 1/4
Mozambique ,,	Fair to fine red ball	1/9 a 2/1
,,	Sausage, fair to good	1/9 a 2
Nyassaland ,,	Fair to fine ball	1/9 a 2
Madagascar ,,	Fr to fine pinky & white	1/4 a 1/6
,,	Majunga & blk coated	1/ a 1/2
,,	Niggers, low to good	6d a 1/6
New Guinea ,,	Ordinary to fine ball	1/4 a 1/7
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	3s 3d a 3s 8d
,,	Consuming mid. to gd.	2s 9d a 3s 2d
	Ordinary to middling	2s 4d a 2s 9d
,,	Mid. to good Kurpah	1s 11d a 2s 5d
,,	Low to ordinary	1s 6d a 1s 9d
,,	Mid. to fine Madras	1/11 a 2/9
MACE, Bombay & Penang	Pale reddish to fine	2/4 a 2/6
per lb.	Ordinary to fair	2/ a 2/2
Java	,, ,, good pale	2/1 a 2/4
Bombay	Wild	1/
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	9½d a 10½d
	80's	7½d
	110's	6½d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20/
NUX VOMICA, Cochin	Ordinary to good	13/6 a 15
per cwt. Bengal	,, ,,	12/
Madras	,, ,,	12/ a 13/
OIL OF ANISEED lb.	Fair merchantable	5/2
CASSIA ,,	According to analysis	2/8 a 2/11
LEMONGRASS oz.	Good flavour & colour	2½d
NUTMEG ,,	Dingy to white	1½d a 1⅞d
CINNAMON ,,	Ordinary to fair sweet	4d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/6½
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	5d
Ceylon ,, ,,	Fair to fine bold heavy	5d a 5⅝d
Singapore ...	Fair	4¾d
Acheen & W. C. Penang	Dull to fine	5d a 5½d
(White) Singapore ,,	Fair to fine	8½d a 8¾d
Siam ,,	Fair	8½d
Penang ,,	Fair	7⅞d
Muntok ,,	Fair	9d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 4/
Canton ,,	Ordinary to good	1/10 a 3/6
High Dried,,	Fair to fine flat	11d a 1/1
	Dark to fair round	9d a 10d
SAGO, PEARL, large—cwt	Fair to fine	18/
medium ...	,, ,,	16/
small ...	,, ,,	13/ a 14/
Flour ...	Good pinky to white	10/ a 11
SEEDLAC cwt.	Ordinary to gd. soluble	65/ a 75/
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 8½d
	Fair greenish	3d a 4½d
	Common specky & small	1½d a 2½d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	72/6 a £6
Bombay ,,	,, ,,	85/ a £6 10/
Mergui ,,	Chicken to bold	£8 12/6 a £14 5
Manilla ,,	Fair to good	£7 17/6 a 13 10
Banda ,,	Sorts	50/ nom.
Green Snail ,,	Small to large	70/ a 85/
Japan Ear ,,	Trimmed selected small to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	14 a 15
per cwt. Madras	Inferior to good	6 a 10
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	12/ a 26/
	Pickings	6/6 a 19/
TURMERIC, Bengal cwt.	Fair	12/ a 13
Madras ,,	Finger fair to fine bold bright	14/ a 16/
Do. ,,	Bulbs ,, ,,	12/ a 13/
Cochin ,,	Finger fair	13/ nom.
	Bulbs ,,	11/6 a 12/
VANILLOES— lb.		
Mauritius ... 1sts.	Gd. crystallized 3½a 8½ in.	9/6 a 15/
Madagascar ... 2nds.	Foxy & reddish 3½a ..	9/ a 12/
Seychelles ... 3rds.	Lean and inferior	9/ a 9/6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares cwt.	Good white hard	47/6

missing Nos 3 & 4

THE

.L AGRICULTURIST:

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EXPERIMENTAL COCONUT CULTIVATION IN CEYLON.

Elsewhere we publish the yields of the Chilaw Coconut Trial ground for 1915 and the first quarter of 1916. The figures for 1915 show that the trees differ considerably in productiveness, due to inequalities in soil fertility of the various plots. For this reason it will be necessary in future to estimate the value of the treatments applied not by absolute results but by proportionate increases or decreases taking each plot as its own control. We find this system more satisfactory in the case of other products as well because absolute uniformity of soil can never be obtained except with pot culture. The scheme of treatment at Chilaw is based broadly speaking upon the effect of artificial as compared with natural cultivation; using the former term to mean particularly the application of artificial manures and the latter the utilization of natural resources at hand. Interest at the present moment centres chiefly on the dry-farming plots which are ploughed twice a year and harrowed monthly to maintain a soil mulch and check the evaporation of moisture. It is, of course, too early as yet to draw any conclusions. The two plots which show the largest percentage of increase in the January-February picking, 1916, as compared with that of 1915 are the Dry-farming plots, 2 and 12; but No. 12 was dressed with sulphate of ammonia in 1915. The present appearance of these plots has induced many proprietors to adopt this system of ploughing and harrowing for working their plantations. It is

labour-saving; it conserves the moisture in the soil for the use of the palms, and it keeps the soil in good condition. A distinction should be drawn between a naturally fertile soil and a soil in good condition. Fertility may be judged by the total amount of essential food constituents such as nitrogen, phosphoric acid and potash present; condition by the amount that is available for the plant, that is to say soluble. Availability is promoted by cultivation. No amount of cultivation could convert say a poor sandy soil into an intrinsically richer soil such as a rich clayey loam; on the other hand a rich soil can be brought to a low state of productiveness by bad husbandry.

Harrowing at Chilaw is done by a disc harrow of eight plates, four on each leaf, or by the Planet Junior horse hoe, No. 4 in size. In this connection we refer our readers to two letters from Colombo firms (published on pages 295 and 296) on the subject of the increase in the demand for ploughs, disc harrows and horse hoes which has arisen recently. The manures for the plots were applied by weighing the exact amount of each ingredient required for each tree, a more accurate method than bulking the ingredients and then dividing the mixture into the requisite number of tree-portions. Plot 14 is against a sheet of water and is irrigated by hand, that being the cheapest and simplest method in the circumstances. A shallow trench is dug round each tree 7 feet from the base and 24 gallons of water are poured twice a week into the trench which is kept covered with a loose soil mulch.

The records for Pitiakande, near Kurunegala, are also published. These experiments are being carried out under the advice of the Department of Agriculture by MR. C. DE E. COLLIN, Superintendent of Pitiakande Group. Here also it will be necessary to take each plot as its own control and on applying this test we find again that the dry-farming plot, No. 4, comes out best with an increase of 93 per cent. in the yield of 1915 over that of 1914. The estate mixture which is producing good results consisted of 2 lb. kainit, 2 lb. castor cake, 10 lb. steamed bone meal and one pound basic slag per tree applied in February. The most noteworthy feature of this mixture is

the preponderance of phosphoric acid. Each tree was given 2·40 lb. phosphoric acid, 0·40 lb. nitrogen and 0·26 lb. potash.

In the experiments with old coconut trees which have been in progress at Peradeniya since 1911, Plot 8 which was ploughed twice annually to keep a loose surface and drive the roots down but not harrowed gave no conspicuous results. The rainfall is ample for coconuts; nevertheless we believe that monthly harrowing would prove beneficial, and it is being practised on a plot of young trees not yet ready to furnish us with results. The most remarkable feature of these Peradeniya Experiments as shown by the tabulated increase in yields is the behaviour of Plot 13, cattle tied. This was the worse plot in the series, yielding only 16 nuts per tree in 1911, but it has now reached third place with an increase of 212 per cent. We may count it as equivalent to farmyard manure. This is the most perfect of complete manures and it is significant that the other complete mixtures, plots 5 and 2, are also high up. The latter was dressed with sodium nitrate, sulphate of ammonia, concentrated superphosphate and kainit and increased its yield 134 per cent. Nitrate of soda alone at the rate of 150 lb. per acre, plot 3, also came out well. Potash alone, Plot 2, did poorly, while the only plot that declined in yield was plot 1 which was slowly being poisoned with common salt.

R. N. L.

ROOT PRUNING.

We take the following description of this operation from a little work entitled The Fruit Garden in India compiled by an officer of the Government Botanic Gardens, Saharanpur, N. India:—

This operation is performed in the case of those fruit trees which make a free growth, but produce little or no fruit. This operation also requires skill and experience. To do this properly, dig a trench in winter 3 feet deep around the tree and about six feet away from the main stem. Any root met with while digging the trench should be cut back to its inner side. If only few roots are met with at the above-named distance from the main stem, then dig gradually closer to the latter all around until you reach a point where root growth is profuse. Then cut off all the main roots to be seen with a sharp knife. When this has been done, mix the turned out soil with one or two dozen baskets of manure and return it to where it was taken from.

COCONUTS.

COCONUT EXPERIMENTS OF THE DEPARTMENT OF AGRICULTURE.

CHILAW COCONUT TRIAL GROUND, 1915.

The crops on the western portion of the estate (including the Trial Ground) Fields Nos. 3, 4, 5 and for the whole estate in 1914 and 1915 are as follows :—

Trial Ground portion of Estate (i.e. Western portion.)

	Average number of nuts per picking.	Total number of nuts.	Average number of nuts per tree for year.
1914 ...	3,469 ...	204,780 ...	59·02
1915 ...	3,535 ...	148,436 ..	41·99
Whole Estate Crop Statement.			
1914 ...	14,223 ...	1,011,488 ...	71·12
1915 ...	14,296 ...	834,028 ...	59·04
Crops from the 15 plots of the Trial Ground.			
1914 ...	— ...	— ...	—
1915 ...	1,289 ...	46,777 ...	34·68

YIELD OF NUTS, 1915.

Plot No.	Treatment.	Bearing Palms.	No. of mature nuts.	Average per tree.
1	Clean weeding	47	1,931	41·08
2	Dry farming	72	2,804	38·9
3	Groundnut cake	89	3,581	40·2
4	Steamed bonemeal ...	81	4,429	54·7
5	Sulph. of Potash	84	3,542	42·2
6	Sulph. of Ammonia ...	78	3,820	48·10
7	Mineral Mixture	92	3,304	35·9
8	Lime and Dry Farming ...	68	2,674	39·3
9	Org. mixture and clean weeding	85	3,383	39·8
10	Central (large weeds removed)	107	2,933	27·4
11	Ring mulching	100	2,861	28·6
12	Dry farming	101	2,936	29·07
13	Dry farming and manure ...	99	1,859	18·7
14	Irrigation	81	2,338	18·4
15	Dry farming	46		
16	Control	59	2,373	40·2

N.B.—Plot 14 is divided from January, 1916, into two of 81 and 46 palms, respectively, the former to be irrigated and the latter to south of road put under dry farming.

Plot 15 to be plot 16; no treatment to be given.

RAINFALL AT CHILAW.

Month.	1913.		1914.		1915.	
	Rain.	No. of wet days.	Rain.	No. of wet days.	Rain.	No. of wet days
January ...	8·45	7	1·13	3	5·95	9
February ...	2·23	4	·28	2	·60	2
March ...	·80	2	3·23	6	1·96	5
April ...	7·45	8	5·30	5	7·10	12
May ...	1·74	4	3·24	8	3·83	6
June ...	1·35	7	4·07	9	3·13	10
July ...	1·89	5	1·41	2	4·77	12
August ...	nil	nil	nil	nil	nil	nil
September ...	0·51	1	1·65	6	1·48	5
October ...	5·15	11	14·29	21	2·38	4
November ...	10·00	10	14·02	10	20·85	18
December ...	9·30	16	11·39	11	1·28	3
	48·90	75	59·74	83	53·33	86

NOTES.

Largest crops generally from April to August, dependent on rainfall about 11 to 12 months previously.

Cost of collecting and picking with bamboos, 60 cts. per 100 trees.

Cost of collecting and picking by climbing, Rs. 1·50 to Rs. 1·75 per 100 trees.

Cost of cleaning trees by climbing, Rs. 1·50 to Rs. 1·75 per 100 trees.

Cost of husking and curing, Rs. 1·37 to Rs. 1·50 per 1,000 nuts. Buyer finds bags and weighs for transport.

Cost of collecting nuts and making 1 candy of copra (1,200 nuts), Rs. 3.

January-February, 1916.—The January-February picking numbered 8,982 nuts (average per palm 7·92) as compared with 6,785 (average per palm 5·25) for the same period last year.

JANUARY-FEBRUARY PICKING OF 1915 AND OF 1916.

Plot.	Treatment	Palms in bearing.	1915 Jan.-Feb.	1916 Jan.-Feb.	Increase per cent.
1	Weeded	47	336	391	16
2	Dry farming*	72	314	668	112
3	Organic nitrogen ...	89	460	673	46
4	P_2O_5 ...	81	602	732	21
5	Potash	84	468	678	45
6	Mineral nitrogen ...	78	630	534	15†
7	Mineral mixture ...	92	504	637	26
8	Dry farming and lime ...	68	591	323	45†
9	Organic mixture ...	85	556	682	23
10	Control	107	518	711	37
11	Ring mulching ...	100	506	556	10
12	Dry farming	101	420	636	51
13	Dry farming and organic mixture	99	250	565	26
14	Irrigation	127	330	380	15
15‡	Dry farming	—	—	411	—
16	Control	59	300	405	35

Plot 12 was worked with the Planet Jr. cultivator.

Plot No. 15 is under irrigation. It was originally intended to use a water cart but on the suggestion of MUDALIYAR A. E. RAJAPAKSE it was decided that the area should be hand-watered, this being the simplest and most practicable method under the existing circumstances. This was accordingly carried out. Two zinc baths were placed on the bank of the river and filled by a cooly; while two other men drew the water from the baths in cans of a capacity of 3 gallons and applied it to the trees. Before the water was applied a shallow trench 1 foot wide and a few inches deep was dug round the trees at a distance of 7 feet from the base. When the water had soaked into the ground the soil which had been dug was loosely thrown over the trench to act as a mulch. In future the whole area will not be exposed but 8 holes will be dug in the area of the circle and the proper quantity applied to each, after which the holes will be closed up. The trees are to be watered twice a week, each tree receiving 24 gallons at each watering.

PITIAKANDE COCONUT EXPERIMENTS.

Plot.	Treatment	Nuts per tree. 1914.	Nuts per tree. 1915.	Increase per cent.
1	Estate mixture	64	103	61
2	Lime	59	96	63
3	Ploughed twice yearly	37	68	84
4	Soil stirred monthly	28	54	93
5	Cattle tied	44	55	25
6	Control (in grass)	43	48	12
7	Phosphoric acid omitted	49	59	20
8	Mineral mixture	49	55	12
9	Organic mixture	30	37	23
10	Control	27	34	26
11	Potash omitted	53	38	28§

* Sulphate of Ammonia, 1915.
† Decrease.
‡ Plot 14 was divided into two from January, 1916.
§ Decrease per cent.

PERADENIYA EXPERIMENTS WITH OLD COCONUT TREES.

Plot Treatment.	nuts per tree 1911	1915	Increase per cent.
1. Common salt, 500 lb. per acre	54	32	41*
2. Sulphate of potash, 200 lb. per acre ...	25	28	12
3. Nitrate of soda, 150 lb. per acre ...	17	33	94
4. Concentrated superphosphate, 200 lb. per acre ...	24	39	62
5. Organic nitrogenous mixture, 800 lb. per acre ...	31	57	83
6. Digging in green manure with basic slag and sulphate of potash ...	29	56	93
7. Green manure with basic slag and sulphate of potash ...	27	49	81
8. Ploughing twice annually ...	29	44	51
9. Inorganic nitrogenous mixture, 750 lb. per acre ...	23	54	134
10. 300 lb. lime followed by No. 5 mixture ...	26	38	46
11. Green manure with slag and sulphate of potash ...	23	36	56
12. Cattle tied two weeks and circle 10 ft. dug ..	22	43	99
13. Cattle tied two weeks every three months ...	16	50	212
14. Control ...	31	42	35
15. Control ...	24	39	62

DRY FARMING IMPLEMENTS.

The Director of Agriculture has received the following letter from Messrs. Brown & Co., Ltd., of Colombo:—

"We have the honour to inform you that our sales for Disc Harrows are certainly going up. We find that our clients like the Massey-Harris 12 Disc machine, but in several sales lately we have cut the machine down to an 8 disc machine, the parts, thimble, washers and discs coming in handy as spares later on.

"The Massey-Harris Co., of Toronto, Canada, do not list a smaller machine than the 12 disc, and we are endeavouring to get a lighter 8 disc machine, but the industrial conditions of the whole world are pretty well upset at present and we are not hopeful of having them here for some considerable time. The abnormal condition of shipping is practically throttling American supplies, and we are only receiving occasional and very limited shipments.

* Decrease per cent

"Planet Junior cultivators show a slight increase, and we find the No. 4 without the adjustable handle the most popular machine. No. 8, although theoretically a handier machine, does not seem to be so suitable for native labour. We realise that labour-saving appliances are now appealing to cultivators."

MESSRS. BROWN & CO. also enclose the following copy of a letter which they have received from MR. R. H. SPENCER SCHRADER of Wester Seaton Estate, Negombo :—

"With reference to your letter of 5th instant, I use a pair of ordinary Sinhalese buffaloes to draw the Disc Harrow. Buffaloes can be trained to draw in a few days and are not only very satisfactory, but are by far the cheapest. The only drawback is that buffaloes cannot be used in the heat of the day. I use them generally between 6 and 10 a.m. The acreage ploughed in any one day would necessarily vary with the depth of the furrow approximately; however, I cultivate an acre in four hours.

I do not know what the life of one of these instruments is, but taking it that it can cultivate only 10,000 acres I work out the cost of working one acre at 50 cents. For hand tilling the cost is about Rs. 5·00."

THE COLOMBO STORES, LIMITED, write under date April 19th, 1916, as follows :—

"We have had a great demand for ploughs of various kinds for the past year. With regard to Disc Harrows we have sold several for this year which are giving entire satisfaction, and have now imported the 8-plate harrow for which there seems to be a great demand."

COPRA FROM QUEENSLAND.

The cultivation of the coconut in Queensland was at one time confined to a few islands off the Torres Straits but is now rapidly extending southwards. The total area under the palm in 1913 was 549 acres, as compared with 365 acres in 1912. Copra first appeared in the agricultural statistics in the latter year, when the production of 31 tons was recorded.

It has been stated that there is a general opinion that coconuts grown in Queensland do not contain sufficient oil to be of commercial value, and in order to test the point a sample of copra was forwarded to the Imperial Institute for examination in July of this year (1915).

The sample which was produced at the Kamerunga State Nursery. Cairns, North Queensland, consisted of clean, well-prepared copra from fair-sized nuts and was in good condition, only a few of the pieces being slightly discoloured.

The copra contained 4·4 per cent. of moisture and yielded 64·6 per cent. of oil: equivalent to 67·6 per cent. on the dry copra. The oil possessed the usual characters of coconut oil and was of good quality, the acidity being very low.

The yield of oil from this sample of Queensland copra is quite equal to that furnished by other varieties of commercial copra. Kiln-dried copra is stated to yield from 63 to 65 per cent. of fat, whilst copra dried in hot air

gives a higher yield which sometimes reaches as much as 74 per cent. There is no doubt that copra containing 67·6 per cent. of oil in the dry material would meet with a ready sale if placed on the market in good condition.

The sample was submitted for valuation to a firm of oil-seed crushers, who treat copra, and also to brokers. The oil-seed crushers reported that the copra was of very fair quality, but they pointed out that it would be desirable to reduce the amount of moisture from 4·4 per cent. to about 3 per cent. They stated that the excess of moisture makes a considerable difference in the value of the copra for crushing purposes, as it renders the material more difficult to grind and consequently reduces the yield of oil obtained on pressing. They valued the sample at about £25 per ton c.i.f., London, (October 11, 1915) and stated that a little extra drying and, if necessary, the breaking of the copra into rather smaller pieces would increase its value by about 10*s.* per ton.

The brokers described the sample as sun-dried copra of good colour and valued it at £24 15*s.* per ton c.i.f. London (October 6th, 1915).

For comparison with these valuations, quotations for the chief commercial varieties of copra in London, on approximately the same dates, are given below:—

NOMINAL QUOTATIONS FOR CURRENT SHIPMENTS OF COPRA TO LONDON.

		October 6, 1915, per ton. £. s. d.	October 13, 1915, per ton. £. s. d.
Malabar ...	Bags	26 0 0	26 15 0
Ceylon ...	,,	25 0 0	26 0 0
Java ...	,,	25 0 0	26 5 0
Singapore ...	,,	24 2 6	24 12 6
Straits ...	,,	23 17 6	24 10 0
Mozambique ...	,,	23 5 0	24 5 0
Manila ...	Bulk	23 0 0	23 12 6
Cebu ...	Bags	23 7 6	24 0 0
Macassar, etc. ...	,,	23 12 6	25 0 0
Zanzibar ...	,,	24 5 0	24 15 0
South Sea ...	,,	22 15 0	23 12 6

The results of this investigation show that the Queensland copra contains a normal amount of oil and that commercial shipments would be readily saleable in London at good prices, especially if care were taken to dry the copra so that it contains not more than 3 per cent. of moisture.

Until recently the bulk of the copra shipped to Europe was crushed in France and Germany. On the outbreak of war, British producers of copra in Ceylon, India, and elsewhere were placed in a serious position, owing to the fact that their produce had hitherto been marketed in Germany and that the war had closed that market. In order to overcome this difficulty the Imperial Institute issued a special circular to British oil-seed crushers calling their attention to the importance of the copra-crushing industry. As a result, a number of British firms have started the crushing of copra and there is now a good market for copra in this country.—Imp. Inst. Bull.

COCO DE MER.

W. B. HEMSLEY.

Much has been written on this singular palm, and its history has been fully recorded, but in my investigations of the flora of Seychelles I have collected evidence on two or three points which were somewhat obscure. Generally, in this country, the botanical name of *Lodoicea sechellarum* is current, and it is the one adopted by the majority of botanists of all countries: but for various reasons other specific names have been published, and sometimes without the corresponding synonyms, giving rise to the supposition that there is more than one species of Double Coconut. Other names coupled with the generic name Lodoicea are: *L. callipyge*, *L. maldavica*, and *L. Sonneratii*. The first was given by COMMERSON in his manuscript account of the palm, but it was not adopted by LABILLARDIERE, who published the earliest botanical description under the general designation of Lodoicea. The name *callipyge* has been revived by some writers, and it is used. without any synonym, in account of germination in a Dutch horticultural publication of 1911.

With regard to the natural distribution of the Double Coconut in the Seychelles, there have been differences of opinion, some writers recording it as confined to Praslin (where COMMERSON discovered it) in a truly wild condition. J. HARRISON, who supplied the material and information for the Botanical Magazine (plates 2, 734—2, 738), 1827, adds the neighbouring Curieuse and Round Islands.

Writing in 1868, DR. PERCIVAL WRIGHT states that "the island Curieuse was the headquarters of Lodoicea. In 1829 this island was selected for a leper establishment, and a MR. GEORGE FORBES was appointed overseer. He was specially instructed not to permit the leaves of the Coco de Mer to be cut nor the nuts to be eaten. Further, he was to plant once a month all mature nuts found on the ground. These instructions were carefully followed out for forty years."

On the other hand, DR. J. STANLEY GARDINER was of opinion that the Double Coconut "was only indigenous in Praslin, and supposed to have been transported to Curieuse by human agency." In reply to my inquiries, MR. P. R. DUPONT, Curator of the Botanic Station, Mahé, writes: "I personally think that the Coco de Mer is indigenous to Curieuse and to Round Island, where there are traces of very old trees on accessible parts. For instance, the famous 'bowl' can be seen in the ground on the hills of Round Island and Curieuse, and on the latter island, besides trees which have been planted near the paupers' camp, there is a great number of very old trees on the summits, where they had certainly not been planted. The soil on the summits of Curieuse is denuded, and the Coco de Mer trees remain stunted, while in Praslin they reach lofty dimensions only in damp valleys. There is no reason why this palm should not have existed in the whole of the Praslin group, which is of granitic formation."

It is well-known that the Double Coconut is usually two-lobed, sometimes three-lobed, and very rarely six-lobed, the last being a complete and perfect development of the three-celled ovary. Male and female flowers are borne on separate individuals, but some confusion has been caused by the

popular use of these terms, two-lobed fruits being known as female and three-lobed fruits as males. Commonly, all the nuts of a tree are either two or three-lobed: occasionally they occur intermixed.

The Double Coconut Palm, besides bearing the largest seed-vessel known, presents some other physiological peculiarities. PROFESSOR STANLEY GARDINER collected such information as he could on the spot, according to which germination takes about three years. Male trees bear their first flowers when about 45 years old, the female trees their first when about 65 years old, and the nuts take seven to nine years to ripen. There is little doubt, however, that these functions and phases are influenced by local conditions, though always of relatively long duration. Particulars of the germination of this palm will be found in the GARDENERS' CHRONICLE for 1888, ii., p. 732.

[Few, if any, plants have aroused as much curiosity as the Double Coconut. From the fact that the fruits are frequently found floating on the Indian Ocean, it was alleged that the tree which produced them is a submarine vegetable. GENERAL GORDON (see GARDENERS' CHRONICLE, Vol. iv., 3rd series, 1888, p. 732) put forward in all seriousness the belief that the fruit *Lodoicea sechellarum* is the "Forbidden Fruit," the instrument of "man's first disobedience," and maintained in conformity with this hypothesis that the Garden of Eden was situated in the Seychelles Islands. Those interested in the plant rather than in the legends and superstitions which it has called forth, may see at Kew a specimen still—or until recently—in the course of its leisurely germination. This specimen when three years old was figured in the GARDENERS' CHRONICLE (XIII., Jan. 21., 1893, p. 74), and although the first leaves had attained a considerable size, the "seedling" had not yet been weaned, but still remained attached to the parent fruit by means of its elongated cotyledon. Although at first sight very remarkable, the seedling follows the pattern of many monocotyledons. The embryo, at first very small, develops a tubular leaf-stalk, the apex of which, remaining within the seed, becomes sucker-like, and serves to absorb and transfer nutriment from the stored-up food of the seed to the young stem and root. The cotyledonary leaf-stalk elongates to form a long tube, which bears at its free end the rudiments of the root and stem. After the tube has passed out of the fruit the stem rudiment forms a leaf, which pushes out from a split in the base of the cotyledonary leaf into the open air, just as does the first leaf of a wheat grain. This is followed by a second leaf, and so on, and during this time adventitious roots, developing at the base of the stem, fix the plant in the soil.—EDS.]—GARDENERS' CHRONICLE.

Six pounds of *Solanum commersoni* were planted at Hakgala in a 242 sq. ft. plot on 13th December, 1915, and harvested on 9th March, the yield being 60 lb. or at the rate of $4\frac{3}{4}$ tons per acre. Tubers from this crop have been distributed to the following:—MESSRS. C. E. HASLOP, S. F. JOHNPULLE, S. W. ANDERSON, R. SIVAGANANAM and H. D. ELHART.

J. J. N.

RUBBER.

A NEW BULLETIN ON RUBBER TAPPING.*

(Continued from p. 76 Vol. XLVI.)

A large part of Mr. Bateson's pamphlet is devoted to the question of latex formation, etc.

In the first place he demonstrates that latex is formed in cells which have recently been cut off from the cambium. If a piece of bark be removed from the wood, cambial regenerations may take place, little bark-islands being formed. If one of these bark islands be pricked it will bleed latex. As there are no means of communication with the rest of the bark on the tree, and also as there are no latex vessels in the wood, the latex must have been formed in cells cut off by the cambium.

As far as the role of latex is concerned Mr. Bateson remarks that the balance of probability is in favour of the theory that latex tubes are merely excretory reservoirs.

It is, of course, a fallacy to suppose that when a tree is rested all the latex is stored up and can be obtained whenever the tree is tapped, for in untapped trees the fate of latex is to be dried up in the outer cortex and finally to be cast off in the shedding of the "cork."

In offering an explanation of the probable reasons for the superiority of the adjacent quarter system of tapping over the single and opposite quarter systems, Mr. Bateson attributes to root pressure the differences observed. In a tree tapped on adjacent quarters the latex, seeking to pass upwards, has only two sideway paths. In the opposite quarter system it has four and will therefore escape more rapidly and the pressure in the bark below the cuts will not be so great as in the other tree. Similarly, the advantage shown by the adjacent-quarter system in causing more starch to be stored in the renewing bark may be explained in the same way.

Two short tapping cuts by providing a side track at each of the four edges would allow more food to pass into the *untapped* bark than one large cut, which provides only two side tracks. The *renewing* bark would therefore suffer by the loss of this starch.

Our present tapping knowledge leads us to anticipate that the adjacent quarter system (or one cut over a half of the tree's circumference) will prove superior to two cuts on one quarter.

In Mr. Bateson's opinion there is no doubt that if trees growing in a soil of average fertility be allowed sufficient space, four years will be found enough for bark renewal. Some interesting remarks are made with reference to overcrowding. When a tree attains a girth of 45 inches the increase in girth will, if the amount of food available remains constant owing to the limitation of the size of the 'crown,' be only two-thirds as rapid as when the circumference was 30 inches. This would mean that bark renewal would take 6 years instead of four.

* F. M. S. Department of Agriculture, Bulletin No. 23.

When trees are close planted, the phenomenon of "drawing-up" of the crown is observed; the crown climbs higher and higher and the food material which might have been used to add thickness to the tappable part of the trunk goes to the formation of long bare stems and branches. Thinning out should therefore be done before "drawing-up" has commenced.

To what extent it will ultimately be necessary to reduce the number of trees per acre cannot as yet be stated.

On the subject of burr-formation Mr. Bateson makes some observations of considerable interest. In the first place the formation of burrs appears to follow coagulation of the latex in the latex tubes, this coagulation in all probability being due to the stagnation of the latex.

Anything therefore which causes isolation of latex vessels may be expected to give rise to burrs.

Three causes of isolation are leaf-fall, disease, and wounds.

When a leaf is shed, latex vessels are cut across and left ending blindly in the cortex—subsequent growth of the tree may completely isolate these vessels.

It has been reported from Buitenzorg that burrs develop in the bark which has been attacked by canker. Canker kills patches of bark and completely or partially isolates latex vessels in the adjacent healthy bark. Mr. Bateson detected the presence of latex vessels in the cores of burrs formed in cankered bark.

Exhaustive tapping also favours the development of burrs owing to the very slow renewal which ensues. The better the tapping and the quicker the bark renewal, the smaller will be the chances of burrs developing.

In addition to the various subjects mentioned above, Mr. Bateson discusses the artificial stimulation of branching and has also reproduced photographs illustrative of Callus formation, etc.

The writer of this article has only briefly described some of the results and conclusions arrived at by Mr. Bateson. The acquisition and study of the bulletin itself is recommended to all interested in rubber plantation work.

L. E. C.

RUBBER FROM ALCOHOL.

I. I. OSTROMISLENSKIJ.

The process of preparing rubber from alcohol, which the writer has already patented, consists practically of two phases.

I. A current of air is pumped through a copper vessel containing the alcohol; the mixed vapours of alcohol and air formed during the passage of this current pass through a series of copper tubes in which are arranged spirals of gauze of red copper and silver. These gauzes are first heated to a dark red heat, and during the manufacturing process, thanks to the great amount of heat evolved in the reactions, remain always incandescent. The mixture of alcohol and air makes its way to the gauzes; the products of the reaction escaping are acetic aldehyde, paraldehyde, water and some of the

alcohol. The rest of the apparatus necessary for this first phase consists of refrigerators and recipients for the separation and fixing of the products obtained. The reaction is produced rapidly, and the amount of the product obtained comes up to the quantity calculated. The expense of rendering the gauzes incandescent is small, seeing that it is only done at the beginning of the operation and that the apparatus can afterwards continue working for several months without interruption. As for the work of the pump, the cost of this is insignificant; the same may be said for the necessary expenses of producing the steam which heats the alcohol to the temperature of 50°C. The process requires no other substances but alcohol and air. The metallic gauzes are consumed very slowly during the operation, as in any other chemical industry.

From 100 parts of 100 per cent. alcohol are obtained 87 to 90 parts of acetic aldehyde or paraldehyde; from 100 parts of 90 per cent. alcohol 78 to 81 of absolute aldehyde.

II. The acetic aldehyde or paraldehyde obtained during the first phase of the operation is mixed with alcohol at 70–90 per cent; the mixture is then passed, in a gaseous or liquid state, through a series of metal tubes containing aluminium oxide heated to 440°–460°C. By this means a volatile carbohydrate, erythrene, is produced; this is collected, either in a gaseous or a liquid condition, in an autoclave.

It is from this moment that the conversion of erythrene into rubber begins. In the autoclave, or in parts of the apparatus where the erythrene is collected, is placed a small quantity of a catalysing substance. The crude rubber obtained is treated with water and dried, as is done in the case of natural rubber, or else dissolved in benzine, after which the catalysing substance is eliminated by mechanical means and the benzine is removed by steam.

Erythrene rubber is a pure chemical product of formula $(C_4H_6)n$. In this condition, the chemical properties of the rubber are different from those of natural rubber, or rather we should say, this synthetic rubber is identical with chemically pure natural rubber, though not with natural rubber as placed on the market. Thus raw erythrene rubber on exposure to air, oxidises more rapidly than the natural product, forming on its surface a crust of unknown composition; hence the necessity of protecting erythrene rubber from the action of air. Another essential difference between the two rubbers is that when subjected to vulcanisation by the action of sulphur alone, erythrene rubber gives a very fragile product, and the vulcanisation process requires much time, so that rubber decomposes before the process is complete. Vulcanisation takes place at a temperature of 135°C.

From the commencement of the experiment, the writer says, it was evident that, in order to give the synthetic rubber all the qualities of the natural product, it would be necessary to add to it a certain number of the substances that are found in the latter. The experiments carried out for this purpose showed that these substances are represented by the following three groups:—

(1) Substances preserving the rubber from decomposition when in contact with air.
(2) Substances accelerating the vulcanisation process.
(3) Substances increasing the elasticity and resistance of the rubber.

The first group consists of tannic compounds, but these have a negative influence upon the quality of natural rubber. The writer succeeded in replacing them by others possessing their good qualities and free from their defects, namely nitrobenzol and its derivatives, and sulphur.

The second group contains nitrogenous substances of undefined composition. According to the writer, they can be replaced by pure nitrogenous compounds, such as diethylamine mixed with oxides of lead, zinc and magnesium. These oxides are inevitably introduced into the rubber when it is vulcanised by the action of sulphur, so that they cannot be unnecessary. The addition of amines brings about surprising effects: 3·3 to 17·6 lb. of amine to 3,432 lb. of rubber accelerate the vulcanisation 40 times.

The third group consists of the so-called "rubber resins"; these are of different chemical composition and structure. The writer states that their place can equally well be filled by colophony, Canada balsam, etc.

In all, it is necessary to add about 15 per cent. of foreign substances to the synthetic rubber obtained from alcohol.

From 100 parts of alcohol the process gives 14 to 18 parts of chemically pure rubber, or 16 to 20·5 parts of the commercial product (including secondary substances, such as colophony, amines, etc.).

On the initiative of the General Direction of Indirect Taxation of the Ministry of Finance, this method of preparing rubber from alcohol has been subjected to qualitative and quantitative tests; the latter were finished in June, 1915.—BULL. INT. INST. OF AGRIC.

THE CLIMATE OF THE PRINCIPAL RUBBER COUNTRIES.

In an article on the climate of the principal rubber producing countries, W. VAN BENNELEN (in "International Rubber Congress met Tentoonstelling," Batavia, September, 1914. "Rubber Recueil," Amsterdam: J. H. DE BUSSY 1915, pp. 145-166, pl. 1), describes the climate of the Amazon and Congo basins, Ceylon, Malacca, Sumatra, Borneo, and Java as follows:—

It is stated in general that "the climate of these countries is purely tropical; that is to say, warm, damp, and equable. The temperature in the plains is 25 to 27° C., (77 to 80·6° F.) declining above the sea level at the rate of about 0·6° for every 100 meters (1° F. for every 300 feet). The percentage of moisture in the air is great, and as a result the pressure of aqueous vapour is proportionately high (× 20 mm.) and the rainfall is more abundant (2,000 mm. = 79 inches and more per year); above all, however, its evenness is the most conspicuous feature of the climate. The yearly rise and fall in temperature amounts to only a few degrees and the daily difference far exceeds the yearly, though even that is not excessive. Periods of drought are seldom of longer duration than two months. The force of the wind is slight, and storms are practically unknown; there are merely the gusts which are forerunners of the many thunderstorms, and these can be pretty violent."—JOUR. OF THE BOARD OF AGRIC., BR. GUIANA.

COCOA.

PACKING COCOA SEED FOR TRANSPORT.

The following report on the Germination of Cocoa Seeds has been received from MR. J. N. MITSUM, Superintendent of Government Plantations, Selangor and Negri Sembilan, by the Secretary, Ceylon Agricultural Society.

1. 6 pods gathered on 22nd January, 1916, and packed in charcoal. Despatched from Colombo 6th February, 1916. Arrived at the Experimental Plantations, Kuala Lumpur, 21st February, 1916. In two pods signs of decay were evident. Several seeds had commenced to germinate. The seeds and pods appeared to be more mature than those in the treated pods. (2) The seeds were planted on arrival singly in bamboo baskets and shaded. Number of seeds received, 230.

On the 5th March, 1916, 50 per cent. of the seeds had germinated. On the 15th March, 1916, 200 of the seeds had germinated and in the majority of cases were showing their first leaves. The remaining 30 seeds had failed to germinate and had decayed. Germination 87 per cent.

2. 6 pods gathered and prepared on 21st January, 1916, by dipping in alcohol, corrosive sublimate, and paraffin wax. Despatched from Colombo 6th February, 1916. Arrived at the Experimental Plantations, Kuala Lumpur, 21st February, 1916. The seeds and pods did not seem to be so mature as those of No. 1. The outer covering of the seeds was very damp. No signs of germination was evident. The seeds were planted on arrival singly in bamboo baskets and shaded. Number of seeds received 277.

On the 15th March, 1916, the seeds were examined and all found to be decayed and dead. Germination nil.

3. 6 pods gathered on 22nd January, 1916; seeds extracted, washed, sundried, and packed in damp mould and charcoal. Received by parcel post at the Experimental Plantations, Kuala Lumpur, 16th February, 1916. The seeds were in rather a heated condition due probably to germination, which in many cases had commenced. The seeds were planted on arrival singly in bamboo baskets and shaded. Number of seeds received 360.

On the 15th March, 1916, 100 of the seeds had germinated and were growing well. The remaining 260 seeds had not germinated and upon examination were found to be rotten and dead. Germination 28 per cent.

Sgd. J. N. MITSUM,
Superintendent of Government Plantations,
Selangor and Negri Sembilan.

NOTES ON THE BUDDING OF CACAO ON AN ESTATE SCALE IN TRINIDAD.

W. G. FREEMAN.

Before dealing with the more recent work on budding I wish to make a few remarks on the grafting of cacao.

That the grafting of cacao was possible was demonstrated by plants exhibited before this Society, by Mr. J. H. Hart, in September, 1898. (Proc. Agr. Soc., iii., 121 and 131). A few plants were established at St. Clair, and there are others on at least one estate in the Colony, but up to 1912 nothing on an estate scale appears to have been attempted in this direction. There is now half an acre in grafted cacao at St. Augustine Experiment Station. One acre has also been laid out at River Estate as part of an experiment.

In Dominica plots of grafted cacao were established at the Botanic Station from 1906 onward by Mr. Joseph Jones. I recently had an opportunity of seeing these and, as the photograph exhibited shows, the trees are of a low bushy habit. Although small, compared with seedling trees, they bear well. One plot of 28 trees, planted out in 1906 and 1907, is giving now an average of 126 pods per tree. A second plot of 52 trees, established in 1907 and 1908, is giving 85 pods per tree; in 1914 the yield was 149·6 pods but was reduced by an attack of root borers from which most of the trees suffered and 10 died.

A third plot of 30 trees, dating from 1910, is yielding 41 pods per tree. Under the conditions at the Dominica Botanic Station grafted trees come into bearing early and give good returns. Full particulars regarding these experiments will be found in the *Annual Report* of the Agricultural Department, Dominica.

Budding of cacao in our colony practically dates from 1913. Two plants had been done earlier in Tobago, but the percentage of failures was so high that the method did not appear likely to be of any estate value. In November, 1913, I exhibited plants at the Board of Agriculture and explained how Messrs. J. C. Augustus and J. de Verteuil had obtained 16 budded plants from 40 attempts. (See Bull. Dept. Agr. xii. 217-21.) In July, 1914, this Society attended a practical demonstration at St. Clair Experiment Station, where the method of budding cacao in bamboo pots in the nursery was shown and the history of budding briefly re-capitulated. (See Proc. Agr. Soc., xiv. 267, and Bull. Dept. Agr., xiii., 235). During 1915, budding has been steadily persevered with at St. Clair, 100 to 200 plants being done each month. The successes have ranged from 36 to 71 per cent. The lower yields were due mainly I believe to the use of stocks which were rather too old. These plants have all been selected Forastero on Calabacillo stocks.

Budding has also been successfully carried on during 1915 at the Tobago Botanic Station, and two small plots established, one of eighteen plants and the other of six, the latter being budded Nicaraguan Criollo.

From plants budded at St. Clair in 1914 and early in 1915, half an acre has been established at St. Augustine. They have made good growth; a well developed specimen planted in July, 1915, is now about 3½ feet high.

Budding of cacao has been accomplished in a good many countries, but there is little if any exact information available from them as to whether it is a desirable method for planters to adopt on an estate scale.

It is an important part of the work of a Department of Agriculture to attempt to decide definitely questions of this character. Even if the results proved that the method was not desirable, it was important, as it saved planters wasting money in useless directions. To this end an experiment had been laid out on a larger scale at River Estate.

The other and not less important question as to whether we can use budding as a means of improving the yield of an established plantation, i.e., by budding on new growths from poor bearing trees, which have been cut back for the purpose, will be dealt with by separate experimental work.

In conclusion I wish it to be understood that the Department is not advocating that planters should as yet abandon seedlings and take up budding on an extensive scale. The Department is working along the lines indicated, to ascertain whether it should advise budding or not. Meanwhile it would be of benefit if as many planters as possible would give budding an experimental trial on a small or a large scale.—PROCEEDINGS OF THE AGRI. SOC. OF TRINIDAD AND TOBAGO.

SUGAR IN INDIA.

According to MR. SAYER, Assistant to the Agricultural Adviser to the Government of India, it is possible to produce all the sugar required by the Indian Empire by improving the methods of sugar manufacture, reducing waste and increasing the output.

India is the largest producer of sugar (crude cane sugar, mostly in the form of *gur*) in the world. The annual production in round numbers amounts to 3 million tons, cane sugar and *gur* about 2, 600,000 tons, palm sugar close on half a million tons. But the annual consumption is over $3\frac{3}{4}$ million tons, which leaves a deficit of over $\frac{3}{4}$ million tons which is met by importation of white sugar from Java and other sugar-producing countries. Our imports of this commodity amounted in 1913-14 to over 800,000 tons.

Can India, besides satisfying her demand for raw sugar, produce the 800,000 tons of white sugar imported from abroad? The official forecast of the current year's area sown with cane is about $2\frac{1}{2}$ million acres, so that if India is to be made self-supporting the cultivation of this crop would have to be enlarged by about 25 per cent. on the existing cultivation, or manufacturing yields should be increased so as to produce the required quantity of both raw and white sugar. It will at once strike any one who has studied the conditions under which sugarcane is grown and jaggery manufactured in this country that the margin for improvement is so enormous that it is not necessary to take the land from other food crops to increase the total outturn.—INDIAN TRADE JOURNAL.

Photo by H. F. Macmillan.

REAPING PADDY.

Paddy grown under the new canal and drainage system, Experiment Station, Peradeniya.

RICE.

RICE GROWING EXPERIMENTS AT PERADENIYA.

The following report by MR. D. S. CORLETT refers to rice grown on the Experiment Station on land irrigated on the new canal and drainage system:—

LOCK'S SELECTED PADDY.

PLOT 1—ONE ACRE—TRANSPLANTED

July 15, 1915.—Nursery sown with $\frac{1}{4}$ bushel of selected seed from last crop.

September 6th.—Transplanted (6 weeks old) single plants 6 in. × 6 in. Insufficient plants to supply one-third of the plot.

September 20th.—Remaining one-third transplanted with plants thinned out from Plot II (broad cast). Total cost of transplanting Rs. 29. Water kept continuously on the fields to the depth of 2 in. only by re-watering every third day approximately. No weeding found necessary.

December 18th.—Paddy in flower. Water allowed 4 days on and 3 days off, i.e., watered once a week.

February 7, 1916.—Harvested (the one-third portion harvested on February 22nd 14 days later). Water completely drained off 10 days before harvest.

Result:—77 bushels of well cleaned paddy and 824 bundles of straw five feet long.

Value 77 bushels @ Rs. 2·15 ...	...	Rs. 165·55	
824 bundles of straw @ Rs. 2 per 100	...	,, 16·50	=Rs. 182·05

197 days or $6\frac{1}{2}$ months.

February 10th.—Land ploughed.

February 15th.—Disc-harrowed and sown with green manure.

PLOT II—$1\frac{3}{4}$ ACRES—BROADCASTED.

August 23, 1915.—Seed broadcasted at the rate of 1 bushel per acre.

September 27th.—Weeded and thinned out by women. Cost of weeding Rs. 30.

December 27th.—In flower.

February 22, 1916.—Harvested.

Result:—$62\frac{1}{2}$ bushels paddy and 556 bundles of straw 4 feet long, i.e., $35\frac{1}{2}$ bushels per acre and 317 bundles of straw per acre (i.e., less than half the yield of the transplanted plot).

$35\frac{1}{2}$ bushels @ Rs. 2·15	... ...	Rs. 76·30
317 bundles of straw @ Rs. 1·50 per 100	...	,, 4·70
		,, 81·00

Difference in value between one acre of transplanted and broadcasted is Rs. 101. 183 days or 14 days less than transplanted.

On the whole the transplanted plot occupied the better fields; a portion

of the broadcasted plot was affected by too much water due to springs in the field; but even so the difference in yield is very marked.

It will be noted that the cost of transplanting is counter-balanced by the cost of weeding the broadcasted portion; the transplanted portion required no weeding.

HONDARAWALA PADDY.

A quarter of an acre of this semi-hill paddy was sown broadcast and about half the amount of water given to ordinary paddy was supplied.

Sown September 6th, flowered December 15th, harvested January 1st, i.e., 116 days or nearly 4 months. The yield was only five bushels or 20 bushels per acre, and inferior straw 70 bundles or 280 bundles per acre.

PHILIPPINE PADDY.

A very small plot of this was planted 6 in. × 6 in. with plants supplied by MR. BEDDEWELA of Kandy.

Planted October 7th, flowered December 21st, harvested January 28th, i.e., 113 days or 4 months from sowing in the nursery. Yield, a quarter of a bushel of medium-sized, round grain containing very white rice. Straw very short. This variety may improve next crop and prove of value.

SOME OBSERVATIONS ON CHINESE RICE CULTURE.

H. O. JACOBSON.

The first distinct impression one receives is that no attempt whatever is made to cultivate rice on soil which is not particularly suitable for it. The habit of carefulness in adaptations of crops to soil and climate is not so marked with other crops, although it obtains to a high degree except in the culture of maize.

The rice fields are found only in the low, level districts, which are located in the river valleys and deltas. No littoral regions were visited. These soils are sedimentary, of fine texture and high initial fertility. Examples of sedimentation are apparent in every big river.

Given a soil of large proportions of silt and clay, a prime requisite is had for rice culture. Lying contiguous to large streams of fresh water the problem of irrigation is more easily solved and it has been solved in these regions. The canals and creeks intersect this area so completely that practically all the land planted with rice is easily irrigated.

The value of a soil for agricultural purposes depends upon the original material from which it has been derived and the state of fineness to which it has been reduced; in addition, for rice culture, there must be added the availability of ample amounts of water for irrigation. These conditions are found to a highly satisfactory degree in the district visited.

It is evident that these areas have been cultivated for a long period, and the question of maintaining soil fertility is certainly interesting. It is hardly probable that there is much organic matter in these soils, the physical appearance indicating the contrary. This should be a splendid field for

Photo by H. F. Macmillan.

STOOKING PADDY.
Experiment Station, Peradeniya.

those who have in recent years been in controversy regarding the ethics of fertilizing, to gather evidence to support their several divers theories.

One very apparent condition regarding which anything is seldom said, is that the huge areas of uncultivated lands and the waterways and lagoons contribute directly or indirectly to the maintenance of the fertility of the cultivated lands. Thus the herbage from the hills and the aquatic plants from the waterways and lagoons pass directly into the soil of the rice fields as green manure or compost. The waste from the fish and the manure from the animals fed with forage produced on the up-lands, also passes into the cultivated soils. When the high ratio of human population to animal population is considered, it is easier to understand how and why the use of night soil for fertilizer has become so common a practice. The importance of animal manure is relatively slight in comparison.

We have heard much about the value of night soil as a fertilizer, but judging by the yields obtained, and the general appearance of the crops viewed, it is the opinion of the writer that eventually it will be discovered that the practice must be amended to include the addition of certain elements in the form of chemical or artificial fertilizers to make maximum production possible.

To one who is accustomed to the large number of varieties of rice which abound in the tropics, the small number found as the northern limits of the rice region is approached is a feature that is appreciated. One of the greatest contributing factors to low yields and wastes in milling is the multiplicity of varieties which obtains in the tropical rice area. The number of varieties of rice grown in the district visited is much larger than it should be.

The appearance of the fields indicated that the soil had been very thoroughly prepared, and at harvest time the absence of weeds of all sorts was remarkable.

Irrigation is continued much later than is ordinarily considered essential. In many cases water was being applied when the harvest was due within two weeks. There appeared to be but one way of raising the water from the canal, creek or lagoon, and that was by means of an endless wooden chain running in a trough, operated by a treadmill, or, in other instances, by a bullock or water buffalo, hitched to a big bull-wheel directly connected to the shaft in the upper end of the trough. This type of apparatus for raising water is almost identical with devices seen in Japan and in the Philippines. As a rule, the water is raised but a short distance, rarely exceeding four feet.

The spacing of hills in the fields was uniform and seldom exceeded 20 centimeters between hills. In some fields the spacing was closer but the figure mentioned appeared to be the average distance. The number of bearing culms per hill was also quite uniform, the number most commonly appearing being nine, ten and eleven. As nearly as could be ascertained, the number of seedlings set in the hill would range between three and five. There were very few missing hills and but very little evidence of re-setting. The number of grains per panicle very frequently was found to be less than a hundred, but panicles were also found which exceeded that number. The kernel type most prevalent was short, broad and thick, white and non-glutinous. This type is very different from the one represented by Saigon rice appearing in the Manila market.

There were a number of awned varieties, and with regard to color of hull, as great a range from pale straw color to black as could be desired.

In the Philippines, lowland rice rarely is less than 100 centimeters in height. The prevailing short straw in the district visited was very noticeable in contrast, since many large areas covered with apparently normal plants had not a hill in which the culms were a meter long.

The writer was informed that the season's crop was the best produced in five years, and if that was the case, the general characteristics observed should be approximately normally developed.

The rice harvest begins in the north and proceeds southward by easy degrees, which is in direct contrast with the wheat harvest in North America, which begins in the south and proceeds northward.

The usual implement used in harvesting is a small sickle with a blade of 15 centimeters in length, attached at right angles to a wooden handle about 20 centimeters long. The harvester cuts a hill at a time, and, if the soil in the field is sufficiently dry, lays it flat on the ground. The usual practice is to cut several rows of hills at the same time, cutting the straw very close to the ground except the one outside row. The outside row is cut about 10 centimeters above the surface of the soil and the handful of rice plants from each hill is laid crosswise of the rows so that the panicles rest on the outside row of stubble. When the field is cut it presents a neat display of windrows, the heads all on one side, slightly raised, and the straw lying neatly and evenly. The crop is allowed to lie until it dries sufficiently so it may be threshed. At that time of the year there is little likelihood of rainfall, so the practice is quite safe.

Certain sections of this district are subject to frequent over-flows and then the harvest method is slightly changed. Instead of putting the handfuls on the ground, small sheaves are loosely bound and these suspended on wooden tripods which are set up in the field as the harvesters proceed.

In the Philippines we find it possible to plant a much larger area with a given number of laborers than can be harvested, and, for this reason, many rice farmers select an early, a medium and a late maturing variety for their fields. This practice is also found in China. The rice farmer who has land subject to over-flow, plants different varieties, so the harvest will be extended over a sufficiently long period that he may handle it with a minimum supply of equipment and with his own labor. It is nothing uncommon to see three or more varieties growing side by side in a field of one-tenth of a hectare.

The unit of land measurement is the *mow* which is equivalent to one-sixth of an acre. To be exact, the legal mow contains 7,260 square feet, but among the Chinese a mow containing but 6,600 square feet is sometimes found, and it may be imagined that the latter size is the one used when yields are computed or land is being sold.

Just as soon as the panicles are sufficiently dry so that the grains will shatter easily, threshing begins. There are three principal methods. In one case a large heavy wooden box, widely flaring and mounted on runners is taken to the field and moved from place to place as required. This box can accommodate four threshers. A large handful of the grain is grasped near the butts of the straw and the grain is removed by beating the panicles against the inside surface of the flaring box. The grain falls down towards the center of this box from which it is removed and carried to the farmer's

house in sacks or baskets. When another method is employed the loose grain is made up into large bundles and carried to the farmer's house either on the man's own back, or packed on donkeys, bullocks or carabao, or carried by boat, or wheel-barrow. The threshing floor, which is a convenient term, but misapplied in this case, is located close to the farmer's house. Sometimes the flaring box is used, but usually a small slanting table on four legs, the surface of the table consisting of wooden slats, is employed. Only one operator can work at each table and he removes the grain by beating the heads against the surface of the slatted table. The grain falls through into a box or basket, or on a mat or the earth as the case may be. Where the amount of grain to be handled is considerable, a threshing floor is made either of baked clay or of stones. The loose grain is strewed about on the floor and a large, tapering corrugated stone roller is drawn about over this material. The roller may be drawn by a water-buffalo, bullock, or by men and women. Occasionally, the roller is smooth and not tapering, but the advantage of using the tapering, corrugated roller is quite obvious. It tends to travel in a circle of a given radius for one thing. Sometimes the animal hitched to this roller is encouraged to move by ingenious means. A common scheme is to suspend a bundle of nice succulent grass barely beyond the animal's head and in his futile attempts to acquire this titbit he proceeds to move around the threshing floor in a highly satisfactory manner. Another scheme is to tie a bundle of grass on one side of the animal's head so that in trying to eat the grass he tends also to move towards the center of the floor and travel in a circle. After the grain is threshed it is spread out on mats in the open to be sundried sufficiently to prevent heating in storage.

A most unusual crop is sometimes gathered immediately after the rice is taken off. This crop consists of bricks. Where the soil is of the proper texture, the rice stubble is shaved off even with the surface of the soil and a knife is run through the soil lengthwise of the plot, cutting the soil into narrow strips of uniform widths. These strips are cut into sections and a trench dug next to the first strip. The knife is then run along underneath and the bricks carefully removed one by one and neatly laid out in the sun to dry. When the bricks are sufficiently dry to permit handling they are piled in ricks for further treatment. This is a case of making bricks without straw, but the numerous fine roots of the rice plant in the soil is a very good binder and serves the purpose admirably.

The feature of greatest interest is yield. Estimates on various fields were given, ranging from 160 to 300 catties per mow. A catty is equivalent to one and one-third pounds avoirdupois, varying slightly according to the three standard catties. These estimates are equivalent to 1,278 to 2,400 pounds per acre or 28·4 to 53·3 bushels of rough rice.

The above figures are regarded as conventional, since in the writer's opinion the yields had a wider range. Many fields did not yield as much as the indicated minimum, and several fields gave every indication of producing considerably more than the maximum. Here, as in all communities, was evidence of difference in the skill and application of methods, according to the individuals. There is not much variation in the methods employed but a great difference in the thoroughness in the application of methods. It was clearly evident that, in one case, we saw the results

produced by a good farmer, in another, those of an indifferent one, and again, the pitiful results produced by the inferior farmer.

In places was noted splendid uniformity of seed; in others the fields showed mixtures of varieties hopelessly inferior.

In the south, notably in the vicinity of Canton, the spacing of hills is more open, the distance often being as much as 40 centimeters, but more seedlings are placed in the hill.

An easy method of irrigating was noted in this district. The lands bordering on the river are apparently more recently formed. At any rate, they lie below the level of the river at high tide. Consequently, when the high tide raises the river water level, the water overflows these rice lands and remains several hours, but as the tide ebbs the water flows off again. This is the least expensive irrigation scheme on record.

In general the rice industry, at least in the regions visited, appears to be standardized to a considerable extent. Through centuries of experience it has been determined that certain lands are most suitable, certain practices reliable and given methods most productive; hence there is but slight variation when one district is compared with another.

It appears that the need is for more rice to feed the people, and this need cannot be met by any revolutionary changes in the industry. The way out lies in the elimination of poor varieties now in culture and the evolution of more productive varieties to be grown instead. That there is a great opportunity along these lines no one who is at all familiar with modern agricultural science doubts.—PHILIPPINE AGRICULTURAL REVIEW.

THE PRACTICE OF IRRIGATION.

The Director of Agriculture of Mauritius referring to this subject says:—"The most important task in practical irrigation is the laying out of the estate into one or more blocks, grading them and constructing the main channels. The essentials to bear in mind are:—

(1) to be able to give every part of the land as nearly an equal quantity of water as possible.

(2) to lay out the fields so that the irrigation will require the least possible amount of labour and so that the water in furrows will not need too constant attention.

(3) to provide for drainage.

(4) to grade canals and furrows so that as little as possible is moved."

In the case of large areas under a tank this task should be undertaken by the Irrigation Department since it is impossible for individual cultivators to tackle the matter which should be dealt with as one scheme for the whole irrigated area.

It is for the Department to prepare a contour plan from levels and divide the land into fields marking in the main canals, providing for catching waste water from the higher fields for irrigating the lower fields and for carrying away the "spent" water by drains.

C. D.

CASSAVA.

CASSAVA: ITS CULTIVATION AND UTILISATION.

The cassava plant, known also as manioc and mandioc, is a native of Brazil, where it has been cultivated from time immemorial. It is now grown in almost every part of the tropics, its tuberous roots often forming the chief source of food of the natives. In European countries the best known product of the plant is tapioca, but in recent years the starch obtained from the roots has been utilised industrially as a source of alcohol, glucose, and dextrin, and as a sizing material for yarns and fabrics. The roots themselves, after suitable preparation, and the residues of the tapioca and starch factories, are largely used as a feeding-stuff for live-stock. Within the last few years considerable interest has been taken in the crop as a source of starch in the West Indies, where the roots have long been cultivated as a foodstuff. Factories for the manufacture of cassava starch have already been erected in Jamaica, Trinidad, and elsewhere.

VARIETIES.

Cassava is a Euphorbiaceous plant belonging to the genus *Manihot*, and is thus closely related to the Ceara rubber tree (*Manihot Glaziovii*, Muel. Arg.) It is a much branched shrub which reaches a height of 12 to 16 feet when allowed to grow naturally, but under cultivation seldom exceeds 6 to 10 feet. The leaves are palmately divided, the number and shape of the lobes varying according to the variety. The flowers are unisexual and are borne in loose, spreading clusters near the ends of the shoots, the male and female flowers being produced on the same plant. The fruit is a drupaceous capsule containing three seeds, each almost as large as a castor-oil seed. The large swollen root tubers are formed in clusters at the base of the stem; they vary in size and number in the different varieties, but are usually from 1½ to 4 feet long, and 1½ to 2½ inches in diameter when gathered, though they may attain a much greater size if allowed to grow for several years.

Two forms of cassava are cultivated. That most widely grown throughout the tropics is the "bitter" cassava, which yields fairly considerable quantities of hydrocyanic acid (prussic acid) from all parts of the root. The second form is the "sweet" cassava, which also yields hydrocyanic acid, but in this case it is derived mainly from the outer cortical layer or skin. They are frequently regarded as distinct species, the first being *M. utilissima*, Pohl (*Jatropha Manihot*, Linn.; *Janipha Manihot*, Kunth), and the second *M. palmata*, Muel, Arg. (*M. Aipi*, Pohl.; *M. dulcis*, Baill.; *Jatropha dulcis*, Rottb.). The two plants, however, are extremely difficult to distinguish in the field, and some botanists consider that the sweet cassava is merely a variety of the bitter form evolved in the course of time by cultivation.

Peckolt, in an account of the cassava plants grown in Brazil, describes *M. utilissima* as a vigorous-growing plant, with dark-coloured leaves, greenish-red or reddish on the under surface, and with red or reddish-purple leaf

stalks. The stems and branches vary in colour from bright-green to blackish and frequently have a reddish tinge; they are always more or less lactescent. The tubers are large with a brown or reddish-brown epidermis of firm texture which can only be removed, as a rule, by scraping; the cortex is white and fleshy, at least 2 mm. thick or as much as 5 mm., and possesses abundant acid latex; the interior of the root is also more or less lactescent and slightly fibrous. *M. palmata*, according to the same author, is less robust, with bright green leaves, whitish or greyish on the under surface. The petioles, stems, and branches are never red, but vary from bright green to greenish-brown. The tubers are smaller than in the other species, and the epidermis is thin, yellowish or light brown, and is easily removed without scraping; the cortex, which is fleshy and white, is about 1 mm. thick, never more than 2 mm., and possesses a comparatively small quantity of very clear, neutral latex; the interior of the root contains no latex and is fibrous in the centre.

Duss, in his Flore de la Martinique, says that the stem of the sweet cassava is not angular and that the stipules are winged, whereas in the bitter cassava the stipules are rudimentary or represented by a prickle with a broad base, whilst the lobes of the leaves of the sweet cassava are somewhat larger and less tapering than those of the other plant.

Although the characters quoted above may be true of the plants grown in the countries mentioned, they do not appear to be of universal application. In Travancore, India, for example, the leaf stalks and stems of several races of sweet cassava are pink or red, and in one case bright scarlet. In Colombia, again, where all the varieties are sweet, the stems are of various colours, ranging from grey and slate to deep red. Even the toxic character of the root does not appear to be fixed. In West Africa, three varieties are stated to occur, known as white, red, and black, according to the colour of the stem. In Dahomey the roots of all three varieties can be eaten with impunity without special treatment; but two of them, the red and the white, when grown on forest soil in Nigeria, are stated to be extremely poisonous, yielding large quantities of hydrocyanic acid.

CLIMATE AND SITUATION.

Cassava is essentially a tropical plant, and can only be grown profitably in regions free from frost for at least eight months during the year. Its growth is stopped by a slight frost or even by continued cold weather. Sweet cassava is hardier than the bitter variety, and is consequently almost the only form grown in regions farthest from the equator, such as Paraguay, Southern United States, and Madagascar. In Brazil, according to Peckolt, the bitter varieties are not cultivated below lat. 26° S., the sweet varieties extending as far as 30° S.

The plant thrives best in regions of comparatively slight rainfall and requires only 14 to 16 inches of rain per annum. In countries where the rainfall is heavy, it is necessary to select well-drained, light soils to prevent water-logging, which is fatal to the plant. Sufficient moisture is necessary to start the growth of the plant but once it has become established it will withstand prolonged and extreme drought without injury, and the crop is never a total failure through want of rain.

Although cassava is sometimes cultivated at an altitude of 2,500 to 3,000 feet the plant matures earlier and gives heavier yields in the valleys. Better results, too, are obtained in regions near the coast than inland.

Sheltered situations should be chosen for the plantation, as the stems are brittle and the plant suffers severely in strong winds.

SOIL.

The best soil for cassava is a rich, light, sandy loam. Recently cleared forest-land is preferred by the natives in most parts of the tropics, as it is rich in plant food and the crop can be grown in it continuously for several years with good yields. Many growers prefer a soil possessing a hard-pan, as in such cases the roots keep near the surface and are easier to dig. As already mentioned, the plant is drought-resisting and will give good results on very dry sandy soil on which no other foodstuff can be grown successfully. Swampy soils should be avoided and also heavy black soils excessively rich in humus; in the latter case the plant makes much top growth and the roots are small. Heavy clay soils are also unsuitable, as they give low yields and the roots are difficult to dig.

PROPAGATION AND PLANTING.

The cassava plant is always propagated commercially by means of stem cuttings. In some varieties seeds are never or rarely formed but even when available they should never be used, as the plants raised from them always give very low yields of roots. Only the middle portions of well-matured, vigorous stems should be used for propagation, the basal, woody part and the extremities of the branches being discarded.

If the climatic conditions are favourable and the land has already been prepared for planting, the cuttings may be taken from the standing crop as soon as the roots are mature; but if there is any possibility of frost, the stems must be stored carefully to prevent injury. In the latter case the stems are usually kept through the winter in whatever length they happen to come from the field, but it is best to cut them off about 6 inches above the soil and trim off the immature branches and leaves, which if left on would tend to cause fermentation and decay. The stems should be cut as late as possible to allow the roots to mature fully but before there is any chance of their being damaged by frost. They may be stored, five or six layers deep, in trenches, much as sugarcane is stored, and covered with soil, in which case the ground should be well drained and dry, as excess of moisture will cause decay. Sometimes the stems are packed upright in trenches about 18 inches deep and 3 to 4 feet wide and covered with straw or litter kept in place by a little soil; or they may be stored upright in low, wooden sheds and covered in a similar way with straw, the outer sides of the shed being well banked up with soil. Whatever method of storing is adopted, care must be taken to see that the stems are not wet when stored; they must not be left exposed to the air too long after cutting and thus allowed to become dry: the covering should be light at first to enable the excess of moisture to escape, more protection should be added as the weather becomes colder, and finally, the covering must be of such a nature as to prevent rain from penetrating to the stems.

The cuttings should not be made until they are required for planting. Their length varies in different countries; some natives use pieces 10 to 20 inches long, but the usua length on well-conducted estates is m 4 to 8 inches, each cutting possessing two or three buds. It is of course essential to use only living stems which are in good condition. Such may be distinguished by their plump appearance, fresh-looking bark, sound pith, and plump beds; any stems which appear shrivelled and are of bleached or

darkened colour, with discoloured or dried pith and shrunken buds, should be rejected. The ends of the cuttings must be cut cleanly. This may be done with a sharp machete or heavy cane knife, or by pushing the stem along a saw fixed firmly to a block, with the teeth uppermost.

The time of planting depends entirely on the climate. If the dry and wet seasons are sharply differentiated, the cuttings should be put in at the beginning of the rainy season, except where the rainfall is very heavy, when it is better to defer planting to near its close. If the rainfall is fairly evenly distributed or the land is irrigated, planting may take place at any time during the year; while in countries where there is an alternation of cold and warm seasons, it should take place as early as possible in the spring, after all chance of frost is past and when there is no fear of the soil remaining water-logged.

In many countries the cuttings are inserted two or three together, at an angle of about 45°, on mounds about 15 to 18 inches high, and sunk for about two-thirds of their length. In the West Indies they are planted in a similar way on ridges or banks. An experiment recently conducted in St. Vincent, however, indicated that better results may be obtained by planting on the level, the yield of fresh roots per acre being 17,570 lb. by the latter method as compared with 14,054 lb. when planted on banks. Whether the cuttings are planted on mounds or on the level, it is preferable to insert them singly, as if strong, healthy cuttings are employed the yield of roots will be as high as, or higher than, when two or three are planted together, and if any selection work is to be done it can be carried out more accurately. Tracy (Farmers' Bulletin No. 167, 1903, U. S. Dept. Agric.) recommends planting the cuttings singly in furrows cut with a plough and covering them with 2 to 4 inches of soil, much as in the case of the ordinary potato.

The usual distance of planting is about 4 feet in all directions, but the actual spacing depends on the character of the soil—the distance being increased on rich soils and decreased on poorer ones—and to some extent on the vigour of the variety planted. In some countries the rows are 4 to 5 feet apart and the plants at intervals of 2 feet or 2 feet 6 inches in the rows.

In order to ensure a regular stand in the field the cuttings are sometimes sprouted in specially prepared beds and then planted out. This method is useful in the case of stems of doubtful vitality, but great care must be exercised when planting out to prevent the young shoots from being injured or broken off.—Imp. Inst. Bull.

TOBACCO ASH AS FERTILIZER.

At a meeting of the Council of the Yorkshire Agricultural Society yesterday (February 3rd) at York, Mr. Thomas Fairley, the Society's analyst, in a report on an analysis made by him during the year, referred to the percentage of potash in wood ashes, and said that if carefully utilized they would form a valuable source of potash in place of German deposits, from which our supplies were mainly obtained before the war. Tobacco ash was especially rich in potash, and the Society would be doing a national service by sending a circular to hotel and restaurant keepers in the country asking them to collect and save such as from their smoke rooms.

Some scheme could be devised for its collection and distribution to farmers, and if this were generally adopted the quantity of available potash salt obtainable would be very large and form a valuable asset to the county.—The Times.

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COTTON.

THE WAR AND THE WORLD'S COTTON SUPPLY.

Mr. John A. Todd, Professor of Economics at University College, Nottingham, contributed an important article to the April-June number of the Bulletin of the Imperial Institute on the question of the world's cotton supply which, he points out, has been critical since the beginning of the present century, for although the world's crops have nearly doubled in that period, the extraordinary expansion of the demand has all the time been pressing hard upon the increased supplies. In five out of ten seasons before the war the world's cotton consumption was actually in excess of the world's crops.

Owing to the temporary fall in prices at the beginning of the war the production of cotton all over the world was very much curtailed. But the world's surplus stocks have now been to a considerable extent worked off, and any revival of normal trade after the war coming upon the reduced supplies of raw material will, it is pointed out, almost certainly produce a severe cotton famine.

Only one thing can be done to prepare the way for meeting this difficulty when it arises, namely, to arouse interest in the development of new cotton fields within the Empire, especially in India, Egypt, and the Sudan, where the work of the British Cotton Growing Association and the International Cotton Federation has already shown the way. Russia has shown wisdom in developing her cotton fields in Turkestan and Transcaucasia, which now supply the greater part of her large native consumption of cotton. Germany, in her own sphere of influence in the Levant, has, it must be admitted, produced large results. That is a point to be remembered in the inevitable rearrangement of the Turkish Empire after the War, as is also the fact that in Mesopotamia we have a potential cotton field, which will probably rival Egypt and the Sudan in quality as well as quantity. But the greatest possibilities for an immediate increase in our cotton supplies lie in India, where great improvements both in quality and quantity have been made in recent years.—Tropical Life.

GIANT RUNNER BEAN.

Mr. Norman Ross of the Chandypore Tea Co., Cachar, India, on 30th January wrote with regard to the Giant Runner Bean:—". . . . . I have great pleasure in testifying to the excellent qualities of the Giant Runner Bean. It commenced fruiting at 6 feet high at the end of November and has been doing so ever since—this notwithstanding I have left 10-12 pods on each for seed. It is very tender and of most excellent flavour. After they had been fruiting about a month I gave them a good sprinkling of mustard oil cake and forked it in—this made them make a lot of fresh growth which fruited at every joint. In my opinion it is the best runner bean I have ever seen."

JAMES J. NOCK.

SOILS AND MANURES.

DYNAMITING SOILS.

W. R. WHITE.

Experiments conducted to determine the influence of dynamiting on (1) the physical condition of soils, (2) soil moisture and drainage, (3) newly planted fruit trees, (4) mature trees, (5) field crops, and (6) insects in the soil are reported. The soils used were the Hagerstown clay loam and Volusia silt loam.

From these experiments it is stated that "while the results......can not be taken as conclusive for all conditions, yet they may indicate that the useful application of dynamite as a soil improver is limited. Its usefulness may depend largely upon local conditions. No definite benefits were derived from its use in either orchard or field crops. What it might do under different conditions, or over longer periods, is yet to be determined. One pond was drained and the other was not. Its usefulness in shooting an open ditch, blasting boulders, and blowing stumps can not be questioned. It may be very useful in draining land where no outlet can be found for a tile drain. How permanent its effect may be is not known. As to destroying insects (ants), it has not proved to be of any use. It is probably safe to conclude that the application of dynamite as a soil improver is greatly limited and that it would always be advisable to try it out in a small way before investing much money in its use."—EXPT. STN. RECORD.

RELATION OF PLANT TO SOIL.

The first two lectures by DR. E. J. RUSSEL, Director of the Rothamsted Experiment Station, was delivered before the Royal Institute on February 29th, on the subject of "The Plant and the Soil-Nature's Cycle."

Setting out with familiar observation that the upper layer of the soil alone is well suited for plant growth, it was shown that this distinction did not always exist. When the soil was first laid down, it was all like the subsoil, but something has happened to bring about the change. Two methods present themselves by which the problem can be attacked; on the one hand some subsoil may be exposed to the weather, and the experiment carried out in such shape that the transformation into surface soil can be closely observed; or, on the other hand, careful analysis can be made of the surface and subsoils with a view to discovering wherein lies the difference between them. The first is called the observational method, and is familiar to all gardeners and field workers: the other is the analytical method, and necessitates laboratory work. In practice, both methods have to be adopted. Strictly speaking, a third method—the synthetic method—is desirable in addition: this involves reconstruction of the soil on the basis of information acquired by the first two methods: but progress has not yet gone far enough for this.

Whenever subsoil is left exposed to the air it begins to cover itself with vegetation. The first plants that come up draw some of their food material from the soil, and they build up their leaf and stem tissues partly out of this and partly out of the carbon-dioxide in the air. The process is in one important respect very much like rolling a ball up a hill—energy has to be put into it; and in this case the energy comes from the sunshine. But neither energy nor matter is ever destroyed in Nature, and, in consequence, when the plants die and their leaves and stems become mingled with the soil, they add to its mineral matter both organic matter and energy.

Direct experiment shows that this addition of plant residues is beneficial to plant growth. Other evidence all tends the same way, and the general conclusion is that the difference between the surface and the subsoil lies largely in the presence of the residues left by the generations of plants that have lived and died there. The problem now is to find why the plant residues are so beneficial.

This is as far as observation will take us; it is now necessary to bring the problem into the laboratory, in order to investigate it further.

The plant residues consist mainly of four elements: carbon and oxygen in large proportions; hydrogen and nitrogen in smaller proportions. In addition, there are lesser quantities of phosphorus, calcium, magnesium, potassium and other substances. The chief reaction in the soil is soon found to be an oxidation: oxygen is absorbed in great quantities, and carbon-dioxide is given out in approximate equal volume. The carbohydrates of the plant disappear very rapidly: some of the cellulose takes longer, and gives rise to the black humus familiar to all gardeners. The nitrogen appears as nitrate. This is not quite what one would expect. In the decomposition of protein as it has been studied in the laboratory—and a prodigious amount of work has been done on the subject—the result is always a remarkable variety of acid, known as amino-acids. Under the action of putrefactive bacteria, the decomposition is carried a stage further, and ammonia and other bases are produced, which are largely responsible for the very strong odour of decaying substances—but nitrates are not found by the processes of the chemist. At first sight, therefore, it looks as if the process of the chemist was quite distinct from that of the soil, but closer study shows that this is not so. All the substances isolated in the chemist's decomposition can be found represented in the soil, and, what is still more to the point, if a trace of choloroform or toluene is added to soil no nitrate is formed, but ammonia accumulates instead. When a trace of untreated soil is added, the process starts again, and nitrate is found as usual. Thus, it appears that ammonia is the precursor of nitrates, and is itself preceded by the amino-acids of the chemist. The difference between the laboratory decomposition and the soil decomposition is simply that the latter is carried several stages further: up to the point reached in the laboratory the two processes appear to be substantially the same. Thus Nature operates in the same way, whether in the laboratory or the field: the differences are only in the lengths to which things go.

This decomposition is absolutely indispensable to the plant: the initial products—the proteins—are useless for plant nutrition; the intermediate products are not much good; the ammonia is considerably better, while the final stage—the nitrate—is the best of all.

During this decomposition energy stored up by the plant during its life-time is run down, so that there is a transformation both of material and of energy. We are accustomed to think of Nature as somewhat prodigal: the vast number of seeds produced by certain plants, the hosts of spores produced by fungi to ensure survival, all indicate this. But in the soil Nature is in a far more economical mood. The energy and material are not wanted: they go to support a vast population of the most varied kind, ranging from the microscopic bacteria to the earth worm. All these depend on plant residues for their food and their energy. But theirs is no case of taking all and giving nothing in return. Their work is nothing less than the production of food for the plant: preparing new plant food out of old plant residues.

Thus we have a great cycle going on in the soil: dead plant residues mingle with it, and give life to countless micro-organisms, which in turn convert them into food for a new generation of plants.

It is necessary to set some limits to the enquiry, and so we restrict ourselves to the production of nitrates. This process is the work of a great number of organisms, some of which carry out the first stages, and others the later stages. It resembles the process of making munitions, in that the first stages can be brought about by a large variety of workers, while later stages are much more specialised, and can be effected only by one or two special workers. Indeed, in the eighteenth century, Nature's process of manufacturing nitrates was actually under the Ministry of Munitions of the time. Great wars were going on which consumed vast quantities of nitrate: there were no Chilean deposits available, and no artificial nitrates: all that was wanted had to be made by this soil process. Nitrate beds were made up, much like cucumber borders; they were kept moistened by liquid manure, etc., and in course of time great quantities of nitrates were formed, which were afterwards washed out.

The process is not free from waste: starting with 100 parts of nitrogen as protein, one never recovers 100 parts of nitrogen as nitrate: there is always a loss. But the fault does not appear to be with the special organisms that carry out the last stages of the process, for at least 96 per cent. of the ammoniacal nitrogen is recovered as nitrate. It is not clear that it lies with the organisms producing ammonia: at any rate, they can work without loss. The probability is that the loss arises from some of the nitrate that has been actually formed.

However it arises, this loss, as well as the leaching out of nitrate by rain, would in natural conditions bring the stock of soil nitrogen to a very low level, if there was no counter-balancing process, and for the last fifty years chemists and bacteriologists have been searching the soil very thoroughly to find out how these gains are brought about. Two sources are now known: the organisms associated with clovers and other leguminosæ and the free living nitrogen-fixing organisms. They differ very much in appearance and mode of life, but for their work they both require a source of energy; for the process of nitrogen fixation, like that of plant growth, is like rolling a stone up a hill. In place of sunlight, these organisms get their energy from the combustion of sugar.

It must not be supposed, however, that the organisms bringing about these changes are the only ones in the soil, or that they lead their lives quite

independently of the rest of the soil population. Indeed, they could hardly do that in any case, for there is only a limited store of food and energy, and whatever is not helping them is hindering them. Numerous experiments show that there is some factor, neither food, air, water, nor temperature, which is operating to keep down these numbers. As it is put out of action by heating to 55·6°C., or by traces of volatile antiseptics, and can be re-introduced by adding a little untreated soil, it is presumably biological, and the evidence shows that it consists in part at least of certain soil amœbæ: it is quite possible, of course, that other forms are involved as well. But whatever the detrimental organisms are, they impede the work of the organisms producing plant food in the soil. Fortunately, they are put out of action more easily than the useful organisms, so that we get the apparent paradox that any process fatal to life (but not too fatal) proves ultimately beneficial to the soil life, while any process beneficial to life proves ultimately harmful. Long frost, drought, and heat, therefore, benefit the useful makers of plant food, while prolonged warmth, moisture, and treatment with organic manures lead to deterioration, or to "sickness," as the practical man puts it.—GARDENERS' CHRONICLE.

INFLUENCE OF BACTERIA ON GREEN MANURES.

L. G. LIPMAN, A. W. BLAIR, H. C. McLEAN, AND L. K. WILKINS.

This is an account of a continuation of experiments previously described (E.S.R., 32, p. 514), the results of which indicate "that the bacteria conveyed in small quantities of manure do have a beneficial effect in the decomposition of the green manure crops. When the green manure crop is a legume, the additional nitrogen thus secured tends to obscure the effects of the manure. The legume is more effective in increasing the yield and also in maintaining the nitrogen supply of the soil than the non-legume, and there is good ground for believing that the nitrogen in the former is more available than in the latter."—EXPT. STN. REC.

GREEN MANURING.

Bulletin No. 56 issued by the Indian Department of Agriculture treats of green manuring (A. C. DOBBS). It consists of a survey of the work done in India.

The practical side of the subject is dealt with reference to plantation crops as well as to the cultivation of rice, tobacco, etc.

The most important recent development of green manuring in India has been in connection with the rice crop.

Experience has shown that the most economical way of growing the main crop of rice is usually to sow the seed in a seed bed and to transplant the seedlings into puddled land when sufficient water has accumulated. This method is almost universal in India, and is being rapidly adopted in the few backward tracts where it is not already prevalent,

Experiments in some of the principal rice-growing tracts of India have proved that the interval between the first monsoon showers and the transplanting of the seedlings can be profitably utilized for the growth of a green manure crop. Under favourable conditions the seed of the green manure crop may be sown at the end of the preceding cold weather and the young crop will survive the hot weather and be ready to take full advantage of the early part of the monsoon.

THE RESPECTIVE VALUES OF ORGANIC AND INORGANIC MANURES.

H. E. P. HODSOLL.

(Continued from Page 247.)

It will therefore be seen from these experiments that organics fully hold their own against the corresponding mineral unit. Further, they are not all exhausted in one year, but leave behind valuable residues for following years. This has been clearly proved at Rothamsted, where the effect of dung has actually been detected forty years after its application. This is not so with mineral ammoniacal manures, which both the Rothamsted and Woburn experiments show are practically exhausted in one year.

It is clear, therefore, that we cannot dismiss the question on solubility only, for, as we have seen, organic manures even supplied in the raw state not only give better results but leave the soil richer instead of poorer, and had the soluble organic manures that are now obtainable been used in the experiments doubtless their superiority would have been even more marked.

This conclusion, of course, will not surprise practical men. We all know the value of dung, crushed hoof, meat and bone stuffs, etc., and that we cannot get good crops by the use of minerals alone, or put heart into a poor soil by the application of superphosphate and nitrate. The point is, why cannot we? Wherein lies the undoubted superiority of the organic manures for these purposes.

I think we can best answer these questions by considering the action in the soil of the two classes of manures from three points of view, viz. the mechanical, chemical, and biological.

1. *Mechanical.*—Let us first examine their effect on the mechanical or physical condition of the soil. Now all organic substances contain humus: that is, they leave behind, after they have decayed in the soil, that valuable residue that we have learnt to associate with the use of farmyard manure or leaf-mould, etc.; and this humus, which more than any other ingredient is always tending to oxidize and diminish in the soil, has very marked effect on its working.

Humus opens a clay soil by loosely binding together the finer particles to which its plastic nature is due. These particles are so fine as to assume when extracted from the soil an almost gelatinous nature, and when they are spread out, or "deflocculated" throughout the soil they make the whole into a sticky unworkable mass, giving the clay what is known as its colloid property. It is this property that enables the potter so to work his clay that he can mould it at will, and upon which the brick-maker relies when he puddles his brick-earth before moulding his bricks.

All practical men are painfully aware of this characteristic of a heavy soil when they try to work it after rain before it is sufficiently dry, and their aim in cultivation is to counteract it as far as possible and so to manage their heavy soils that they may crumble down into a fine and workable condition.

Humus greatly assists in this endeavour by collecting together or "flocculating" these fine particles; perhaps the simplest instance of this action of humus is that afforded when a piece of old grass land naturally rich in humus is ploughed up, especially if the soil be heavy. After the winter it will crumble readily, so as to harrow down to a mellow seed-bed while on a neighbouring piece of the same soil that has been arable for some time a number of large unyielding clods will probably be noticed.

Again, on a light soil, humus, by acting in a contrary direction, has an equally beneficial effect; in this case it loosely binds together the coarser particles, imparting to the soil more of a spongy or retentive nature.

This mechanical effect of humus leads to the following advantages in soils well supplied with this important ingredient:—

The land retains much heat otherwise lost, and, being warmer, the crops consequently ripen earlier.

The land dries more quickly, yet retains its moisture better in drought.

The superfluous moisture from storms and heavy showers is held as by a sponge and passes downwards gradually; thus all wash is avoided; the water retaining power of a soil well supplied with humus is 20 per cent. greater than that possessed by a mineralized soil.

In dry weather the land cools sooner and more dew is precipitated. The air passing over humus-fed soil is cooler and moister than the air passing over a mineralized soil; the rainfall will therefore be greater. If the soil all over the country were richer in humus the rainfall would be more uniform, as in countries covered with forests.

The soil, being more open, is better ærated, and consequently more plant food is set free.

Much manurial matter that would otherwise leach away is retained.

The plants are healthier; a soil deficient in humus is always more likely to support disease: clover sickness and finger-and-toe are never so prevalent on soils showing a high humic content.

Of this fact the Indian coffee planters are well aware; as long as their soils were well stored with the vegetable matter of the primeval forests which previously occupied the site of their plantations there was very little disease among the plants; as soon as the humus became exhausted diseases increased, but have again been reduced by adding the top soil from the neighbouring forest lands.

The importance of a good tilth and a good seed-bed cannot be over-estimated; in fact, if the weather conditions are adverse to the start of a crop, the eventual yield will often depend more on the physical condition of the seed-bed than upon any other factor. No better proof of this fact could be given than that afforded by Table I. from the Rothamsted experiments given above. As has been previously pointed out, there are always more roots on the rape cake plot than on the others, showing that the conditions are far better for the young plants; in fact, the physical condition of the soil where only minerals are used has become so bad that only in favourable seasons is a good plant obtained and on three occasions the sowings have completely failed, whereas the rape cake plot always starts regularly.

Against these many advantages of the humus-containing organic manures we have to place the distinctly bad effect that most mineral manures are known to have on the physical condition of the soil.

Probably nitrate of soda is the worst, owing to the fact that the residue it leaves behind in the soil—caustic soda—deflocculates the clay, which consequently becomes puddled.

Sulphate of ammonia and superphosphate leave an acid residue which is harmful to plant life, and still more so to bacterial activity.

It is true that those minerals which leave lime as a residue in the soil, such as basic slag and nitrolim, are not subject in the same way to this objection, but it is undoubtedly true to say that one of the great advantages of organics over inorganics is that the former materially improve the texture of the soil by increasing the supply of humus, and thus enable a good seed-bed to be obtained and a good tilth maintained, whereas the latter, generally speaking, have an opposite effect.

2. *Chemical.*—Under this heading I want to consider the chemical form in which the food materials exist in the two classes of manures, and to show how this affects the feeding and consequent growth of the plant.

The outstanding feature of organics from a chemical point of view is that the food materials they contain are not all present in one form, but exist in a large number of different and complicated chemical compounds; and it follows that these compounds, being differently constituted, vary greatly in their availability as plant food, and therefore come into use (chiefly by the aid of bacteria, as we shall see later) gradually and continuously.

On the other hand, the minerals are mostly definite chemical salts of known and comparatively simple composition; it follows, therefore, that the conditions—of temperature, moisture, etc.—that render one of their food units available for the plant will have the same effect on the rest, so that the whole becomes available for the plant at the same time. This not only means that while this process is taking place the plant has too much food, but, being unable to take it all the remainder is washed out of the soil and lost, and is not there when the plant is ready to take in further supplies. This objection, of course, particularly applies to the highly soluble nitrogenous manures, nitrate of soda and sulphate of ammonia.

It has been abundantly proved that, for good quality in the product, manures that come steadily into use throughout the season are required, rather than the very active ones that induce a sudden rush of growth.

Further, the gradual availability of organics builds up a reserve of food material in the soil, so that eventually the land becomes stored with manurial residues.

It must be remembered that the soil is more rapidly exhausted of ammonia than of phosphate or potash, so it is particularly necessary that ammonia should be obtained from an organic source. That this fact is realised by horticulturists is proved by the demand for organic ammoniacal manures, the higher price paid for these per unit over the minerals being greater in proportion than that paid for the organic as against the inorganic units of phosphates.

HALL states in one of his well-known works: "The hop grower, for instance, won't get the quality he wants by substituting a mixture of super and sulphate for the guanos or organic manures he has been accustomed to use;" and again:

"It is only a lasting manure which accumulates in the soil to build up 'high conditions,' the state of affairs which prevails when reserves of manure in the soil are steadily and continuously passing into the available condition in sufficient amount for the need of the crop, a state of affairs which results in healthy growth of good quality."

It is evident, therefore, that the slow and gradual solubility and lasting nature of organics is of the utmost importance, and is another reason for their superiority over the minerals, which, as I have shown, do not possess these valuable qualities.—JOUR. OF THE ROYAL HORT. SOC.

INFLUENCE OF SOIL ON THE AVAILABILITY OF MANURES.

J. G. LIPMAN, A. W. BLAIR, H. C. McLEAN, and L. K. WILKINS.

This is an account of a continuation during 1914 of experiments begun in 1911.

It was found that sodium nitrate and dried blood when used on mixtures of sand and shale soil, varying in proportion from 10 to 90 per cent. sand, gave higher yields of dry matter and nitrogen in the first crop than when used with loam soil alone or sand alone. With the first crop sodium nitrate invariably gave higher yields than dried blood. "The average recovery of nitrogen with nitrate of soda for the first crop was 60·52 and with dried blood 43·92 per cent. The highest recovery with nitrate of soda was 71·17 per cent. where the mixture contained 70 per cent. of sand, and the highest recovery for dried blood was 56·3 per cent. with 80 per cent. sand. Taking 100 as the availability of the nitrate of soda for this crop, the availability of the dried blood was 72·07 .... In four out of ten series no nitrate nitrogen was recovered in the second crop, and, with one exception, the recoveries from the other six were low. The average residual recovery from dried blood for all series was 11·05 per cent."

With reference to the total recoveries of nitrogen, the sodium nitrate stood first in all cases, except where sand alone was used. In this respect the dried blood showed an availability of 85·66 when sodium nitrate is taken at 100.

These results are taken to indicate that a marked residual effect can not be expected from a moderate application of sodium nitrate, but that some residual effect may be expected from dried blood in nearly all cases. Mixing sand with heavy soils was found to permit better æration and drainage and to result in a more complete utilization of the soil organic matter.—EXPT. STN. REC.

DRYING THE SOIL.

For the planting or sowing of all crops it is essential that the surface of the soil should be dry. To attempt to crop wet land would cause a greater failure than waiting several weeks. The smaller the seeds or the plants, the drier should be the soil. A light soil will often be fit for sowing after a day's sunshine and wind, but in the case of a heavy soil measures must be taken

for hastening the drying by loosening the soil to a depth of three inches with a hoe or a drag. In doing this, undue treading on the soil must be avoided. On a small, narrow plot it is possible to loosen the greater part of the surface by the use of a long handled hoe or drag, while the operator stands on the path. When it is impossible to reach all the plot by this means, the treading on the soil can be considerably reduced by taking long strides while working, and moving the feet as little as possible.

It may be necessary to loosen the soil thus two or three times, the last time with a long-handled wooden rake. The soil will be quite ready for raking down fine and drilling for seeds when it does not cling to the boots or the tools. The seeds can only be properly covered when the soil is made so fine that the lumps are approximately no larger than a walnut. If the weather seems likely to be fine throughout the day it is an advantage to drill the ground early in the morning and to sow in the afternoon. This affords a further opportunity of getting the soil, which is to cover the seeds, quite dry.—THE TIMES.

POT EXPERIMENTS ON THE AVAILABILITY OF NITROGEN IN MANURES.

J. G. LIPMAN, A. W. BLAIR, H. C. McLEAN, AND L. K. WILKINS.

The object of these experiments, which supplement plot experiments previously noted (E. S. R., 31, p. 124), was to determine the availability of a number of organic and inorganic nitrogenous fertilizers as compared with that of sodium nitrate. In the first four experiments pots containing 20 lb. of sand were used.

A comparison of sodium nitrate, ammonium sulphate, tankage, and cotton-seed meal, when added to barley in sand, in amounts equivalent to 616 mg. of nitrogen per pot, showed that the highest average yield of dry matter was with ammonium sulphate and the next highest with cotton-seed meal, while the highest content of nitrogen in the dry matter was obtained with sodium nitrate and the next highest with ammonium sulphate. The amounts of dry matter of a second crop grown in the same pots without further fertilizer treatment were much less than those of the first crop in all cases, as was also the nitrogen content, except where cotton-seed meal was used. The total recovery of nitrogen was greatest with sodium nitrate and the next highest with ammonium sulphate. These results are taken to indicate that a comparison of sodium nitrate with equivalent amounts of materials not so rapidly available is not fair if the application is small or moderate and if only one crop is grown.

A comparison of sodium nitrate, alfalfa meal, green rye, dry blood, and cotton-seed meal, when added to buckwheat in sand at the rate of 462 mg. of nitrogen per pot, showed that sodium nitrate gave the highest average yield and dried blood was second. A residual crop of barley was largest on the nitrate pots, but all the recoveries were low.

A comparison of sodium nitrate alone and in combination with vegetable and animal organic matter and with the organic matter alone, when added to buckwheat in sand in amounts equivalent to 616 mg. of nitrogen per pot, showed that the residual effects from the use of sodium nitrate were small if the first

crop developed normally, but were considerably increased where an excessive amount of the nitrate depressed the yield of the first crop. The residual effects from the use of organic nitrogenous materials were greater than those from nitrate of soda, but were small when considered from the standpoint of the amount of nitrogen that apparently remains in the soil after the removal of the first crop. Nitrogen applied in the form of nitrate of soda and organic matter, half the nitrogen from one and half from the other, gave a higher yield of dry matter and a higher recovery of nitrogen than nitrogen which is all in the form of organic matter.

A comparison of sodium nitrate with ammonium sulphate, ammonium nitrate, calcium cyanamide, calcium nitrate, dried blood, green rye, and alfalfa meal, when added to buckwheat in sand in amounts equivalent to 308 mg. per pot, showed that the highest average yield was obtained with calcium nitrate and the next highest with ammonium nitrate. The lowest yield obtained with calcium cyanamide. In general, the percentage of nitrogen in the crop receiving organic materials was lower than in that receiving minerals. The highest recovery of nitrogen was with sodium nitrate and the next highest with calcium nitrate.

In pot experiments with buckwheat on a loam soil, using green manures, sodium nitrate, and ground limestone, the purpose of which was to determine the effects of ground limestone in the decomposition of organic matter, it was found that in every instance the average yield of dry matter was higher with ground limestone than without, whether used with green manure alone or with green manure and sodium nitrate. The percentage of nitrogen in the crop was invariably higher where sodium nitrate was used with the green crop, either with or without lime. These results are taken to indicate that the limestone aided the decomposition of the organic matter and increased the availability of the nitrogen.

In a final experiment with barley on a mixture of sand and loam to determine the effect of vegetable matter in the soil on the germination of seed and on the growth of the crop and the effect of ground limestone on the decomposition of vegetable matter, it was found that the ground limestone had a beneficial influence on the decomposition of the organic matter and in making the nitrogen of this available. No effect of the vegetable matter was observed on germination.—Expt. Stn. Rec.

THE NITROGEN PROBLEM IN ARID SOILS.

C. B. LIPMAN

Amongst the various problems relating to arid soils, especially in California, recent investigations and certain observations in actual practice have brought out the importance of the nitrogen problem.

From the various data collected the writer draws the following provisional conclusions having a practical bearing :

(1) The introduction and maintenance of a good stock of organic matter in the form of green manure or dung should be practised on all soils deficient in nitrogen or organic matter.

(2) The nitrogenous manures applied to these soils should be high-class organic manures such as steam-bone flour, cotton-seed meal, sewage residues, and in other cases sulphate of ammonia.

(3) It is necessary to prevent heating of the soil, excessive evaporation and oxidation of organic matter, by means of a mulch of straw or dung. This is one of the most important practices in soil management in Californian gardens and vineyards deficient in nitrogen and organic matter.—BULL. OF INT. INST. OF AGRIC.

RESULTS OF THIRTY YEARS OF LIMING.

W. H. McINTIRE

Field experiments with burnt lime with and without manure, ground limestone, and gypsum on a silty clay loam soil are reported, the purpose being to ascertain (1) to what extent and depth applied lime descends into the subsoil, (2) the amount of lime conserved and lost by cropping and leaching, and (3) the effect of lime upon the chemical composition of the soil. The crops grown were corn, oats, wheat, and grass. Burnt lime and ground limestone were applied at the rate of 4,000 lb. per acre, gypsum at the rate of 320 lb. per acre and manure at the rate of 6 tons per acre.

Where lime was applied alone increased crop yields were obtained only with ground limestone. Burnt lime decreased the organic matter of the soil when applied alone and decreased humus accumulation when applied with manure. Calcium sulphate and ground limestone increased the organic matter. Each form of lime increased the nitrogen content of the soil, gypsum-limestone, and burnt lime being effective in the order given. The addition of lime to manure increased crop yields and the nitrogen content of the soil. More lime was removed from the surface in the case of ground limestone and when lime was used with manure than when burnt lime was used alone. Manure induced more thorough dissemination of lime throughout the entire 21 in. of soil, at the same time conserving it.

Gypsum decreased the calcium carbonate content of the soil, but increased the total calcium oxide content. The highest occurrence of inorganic carbon dioxide was due to ground limestone, burnt lime with manure being second, and burnt lime alone third. In general the carbon dioxide content decreased with the depth, as did also the lime content. Approximately 36·8 per cent. of the lime applied with manure, 39·7 per cent. of the burnt lime applied, and 40·3 per cent. of calcium oxide of the limestone, treatment were found to exist as carbonates. Approximately 24·3 per cent. 15·9 per cent. and 22·5 per cent. of the calcium oxide applied to three different plots occurred in forms other than carbonates.

The magnesium percentage decreased in every instance, the loss being greatest in the first 7 in. and least in the last 7 in. Every case of lime treatment resulted in a decreased total potash content. No correlation between residual lime and residual potash was found. Phosphorus was conserved where lime was applied as burnt lime, both with and without manure. The effect of ground limestone was not so marked upon the phosphorus conservation as was that of burnt lime, while a loss occurred in the plots treated with gypsum.—EXPT. STN. REC.

NITRIFYING ORGANISMS IN THE SOIL.

E. J. RUSSELL.

The story of the nitrifying organisms is an old one, but it bears re-telling. Only two organisms are known that can change ammonia to nitrite, and only one that can change nitrite to nitrate. All three are extremely small, and they are unique in that they build up their substance out of carbon dioxide, obtaining the requisite energy from the oxidation of the ammonia, and not from sunlight, as plants do. They do not require organic matter for food or for energy supply—again a distinction from other micro-organisms; indeed many organic compounds are harmful to them. This property is so marked in culture solutions that all organic matter was long supposed to be harmful, but this is now known to be incorrect. Nitrifaction will take place in presence of organic matter; it is known to go on during sewage purification, and it takes place regularly on the other side of a dungheap. But there are two conditions which are highly detrimental to the nitrifying organisms, viz. acidity and lack of air. Provided these are avoided, the organisms will tolerate soil organic matter.

Running alongside of this decomposition is another. The amount of nitrate formed is never as great as one expects from the nitrogen in the protein, and the deficit is attributed to a loss of gaseous nitrogen. We have, therefore, two possibilities: the protein may change to nitrate or it may change to nitrogen.

Now the evolution of gaseous nitrogen is of no value whatsoever to the farmer or the gardener: on the contrary, it represents a dead loss, because the nitrogen is only dissipated. It is difficult to exaggerate the seriousness of this loss to the intense cultivator. One of our plots annually receives the liberal but by no means excessive dressing of fourteen tons dung to the acre, containing 200 lb. of nitrogen. Of this about 50 lb. is recovered in the crop and about 25 lb. remains in the soil; some also gets away in the drainage water. But about one half of the nitrogen cannot be accounted for, and presumably it goes off as gas; at any rate the cultivator gets no benefit from it.

It is impossible to form a precise estimate of the losses of nitrogen in a market garden, but the conditions all favour high losses; still more do they do so in glasshouses where crops like cucumbers are being grown.

The market gardener is compelled to manure heavily in order to secure heavy crops, and his loss of nitrogen simply represents the extra price that always has to be paid whenever production is forced beyond a certain level. But just as the engineer has learnt how to increase the efficiency of an engine, so the cultivator has to learn how to increase the efficiency of his production processes. This cannot be accomplished until the nature of the soil-changes is better understood and the cause of the loss of nitrogen has been revealed. The action in the soil is too slow to allow of easy investigation; it is marked enough to cause serious loss over an acre in a year, but not in the small amount of material one uses in the laboratory and the limited time available for an investigation.

Tables showing Losses of Nitrogen from Cultivated Soils, Broadbank Wheat Field, 47 years, 1865-1912.

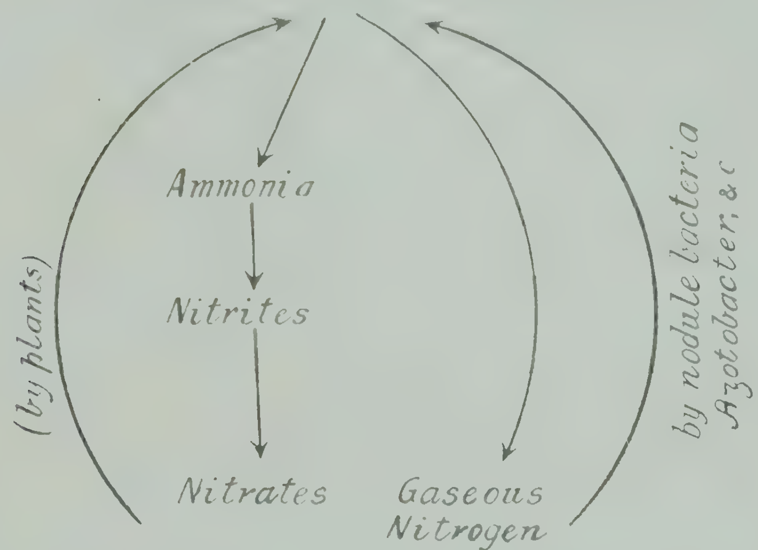
	Rich Soil (2) lb. to the acre.		Poor Soil (3) lb. to the acre.	
N. in Soil, 1865 ...	175 %	4340	150 %	2720
N. added in manure rain (5 lb) seed (2 lb) ...		9730		330
N. expected in 1912		14070		3050
N. found in 1912 ...	245 %	5730	103 %	2510
Loss from Soil ...		8340		540
N. in crops ...		2550		750
Balance being dead loss		5790		210
Annual dead loss ...		123		5

When a difficulty of this sort arises the method adopted is to study parallel cases where the action is more pronounced. Two of these are being studied in some detail: the loss from a sewage bed and the loss from a manure-heap. Sewage presents a particularly interesting case, because here the loss is actually utilized as a means of sewage disposal, and the sewage chemist tries to encourage it just as strenuously as the agricultural chemist is trying to stop it. Indeed the situation is not altogether devoid of humour, for the community on the one hand spends many thousands of pounds in destroying nitrogen compounds in its sewage works, and on the other spends many thousands of pounds in purchasing nitrogen compounds for its soil. It was to find some way of bridging this difficulty that the Hon. Rupert Guinness came forward and enabled us to secure at Rothamsted the services of Mr. E. H. Richards, late of the Sewage Commission investigations, to make a systematic study of these losses. At Rothamsted we have selected the manure-heap because of its special agricultural and horticultural importance; in France, Minitz and Laine took the sewage-bed. For a long time it was uncertain whether the gaseous nitrogen arose direct from the proteins by a process analogous to combustion or whether it was formed by decomposition of the nitrates. The problem is not yet solved, but the evidence is steadily accumulating against the combustion hypothesis, and so far as it goes it indicates that the nitrogen passes safely through the ammonia stage but gets lost afterwards. If this turns out to be correct, an interesting method of reducing the loss, if not of preventing it altogether, will become possible. It is obvious that if the ammonia (or the nitrate into which it is converted) is absorbed by the plant it cannot give rise to gaseous nitrogen in the soil, and therefore the loss will be eliminated by arranging the conditions so as to facilitate absorption by the plant. It has been shown in agricultural practice that absorption of nitrate is greatly facilitated by properly balancing the manures, and we may hope for a good deal by adopting the same plan in horticulture. At present horticultural practice is to say the least, indiscriminate, and there is considerable scope for improvement.

Again, however, a cycle is operating: opposed to all this loss of nitrogen are two sets of processes by which the losses are made good and nitrogen is fixed in the soil.

THE NITROGEN CYCLE IN THE SOIL.

Complex Nitrogen Compounds.



The growth of leguminous crops, as is well known, adds to the stores of nitrogen in the soil through the combined operations of the plant and the organisms present in the root nodules. Leguminous plants occur in nearly all natural vegetation and their activity is very wide-spread, constituting by far the most considerable source of added nitrogen.

The second source of increased nitrogen is to be found in the activities of certain free-living bacteria which can fix nitrogen on their own account and do not require the co-operation of a living plant. At least two of some importance are known: Clostridium, which was the first to be discovered, is an anærobic organism, i.e. it works in absence of air, but it can form a close association with ærobic organisms so that it can work in presence of air, and certainly its action is not precluded in the soil. The second, Azotobacter, is more potent and has proved far more attractive to investigators. It works very vigorously in crude cultures, but is less active in pure cultures; it used to be supposed to lose its potency on cultivation, but recent work has shown that it remains active in a suitable medium.

Both Clostridium and Azotobacter build up complex nitrogen compounds from gaseous nitrogen, a process that requires energy; and both draw the necessary energy from the oxidation of the plant residues—presumably the carbohydrates—in the soil. It is reasonable to suppose that both organisms are active in the soil, but no rigid proof has ever been given. The fact that land laid down to grass tends to gain nitrogen has been adduced in proof, but it is not really satisfactory.

Table showing gain in Nitrogen in land laid down to Grass in 1856 and mown annually. Rothamsted.

	1856	1879	1888	1912.
Per cent. of Nitrogen in top 9 inches.	·152	·205	·235	·338

On such land the ammonia and nitrates are assimilated more rapidly and completely than in arable land, and there is therefore less liability to loss of

nitrogen; further, leguminous herbage almost invariably grows for part if not for the whole of the year, making additions to the nitrogen supply. There is nothing to preclude the action of the free-living nitrogen fixers, but nothing to prove it.

These accumulated nitrogen compounds, whether built up by organisms associated with the Leguminosæ or by the free-living forms, all break down by the processes just indicated and pass into nitrates with or without loss of gaseous nitrogen, according to the conditions.

From the standpoint of plant nutrition we may look upon the formation of nitrates in the soil as being the most important of all the processes, and for long it was regarded as probably the only one with which the agricultural chemist need concern himself.—Jour. of the Royal Hort. Soc.

THE EFFECT OF CLIMATE ON SOIL FORMATION.

J. W. LEATHER.

There are two soils in India whose mode of formation is still unexplained, viz. the laterite and the Regur or Black Cotton Soil. These two soils are very distinct in several characteristics. The Regur is black or dark brown in colour: when wetted it expands to an unusual degree and on drying large fissures form in it; it retains unusually large amounts of water; it is practically devoid of stones except where near rock formations aud frequently contains 5 to 10 per cent. of calcium carbonate, though the proportion of this constituent sometimes falls to less than 1 per cent. It rests on various rock formations, partly on the Deccan trap, on the metamorphic rock in Southern India and on the Cuddapah quartzites.

Laterite when first exposed is soft and light coloured, but rapidly hardens on exposure, and after breaking down to soil is red; it frequently or generally contains gravel, including limonite, but otherwise the soil has no special physical features. Like the Regur soil, however, it rests on various formations, the association being remarkably alike in the two cases.

At one place in the neighbourhood of a bed of Regur it is possible to find the rock taking the dark colour of Regur and at another not far away the same rock is weathering to red soil. Thus the formation of these two soils from the same rock cannot therefore be simply attributed to either weather or climate.

Holland has previously shown that the formation of laterite soil is more easily accounted for on biological than on chemical grounds. Possibly also the case of the Regur soil may be an instance of bacterial activity.—Bull. Int. Inst. of Agric.

SERICULTURE

IN SOUTH INDIA.

T. V. RAMAKRISHNA AIYAR, B.A., F.E.S., F.Z.S.

(*Continued from page 256.*)

The Diseases of the South Indian Silkworm.—Similar to the silkworms of other countries the South Indian insect is also subject to numerous diseases. These go by various vernacular names. In Kollegal the chief ones known are (1). *Sarpikke.* During the later stages of the worm the insect passes its excretion in the form of a *sara* or chain and most of the worms that do so die before spinning. This disease is called sarpikke. (2). *Ginnu.* This disease is denoted by a swelling at the back during the later stages of the worm and gradual death. (3). *Kenchu* is a turning into red of the worm after the fourth moult; the worm remains inactive and shrinks. In Berigai also the rearers have some diseases such as 'Lāl' or red disease, swelling disease, etc., but the definite characters of each are not known. Other local names of some of these diseases are 'Chappay', 'Hālhula' (white worm), etc. Most of the diseases appear during the later stages in the life of the worm. It is almost certain that many of these diseases prevailing amongst silkworms in Southern India must be identical with those met with in other silk rearing countries, since experts like WOOD-MASON and MUKERJI have found out that the silkworm diseases in Bengal are the same as those of Europe. From a rough comparison of the characteristics of the local diseases it appears that what is called 'Sarapikke' is Flacherie, *Ginnu*, Grasseri and *Kenchu*, Pebrine. MUKERJI is of opinion that the silkworms in Southern India are chiefly subject to Flacherie and that they are more or less free from Pebrine. The writer is, however, led to believe that Pebrine also prevails in Southern India since he has had the opinion of experts on diseased worms forwarded for examination. There is very little doubt that a good percentage of worms reared in Southern India succumb to these diseases and it is to this cause that we must attribute the gradual decline of this industry to a very great extent. Since writing this a good deal of evidence has been gathered to prove the existence of Pebrine in Southern India.

The food of the South Indian Silkworm: Mulberry.—The mulberry plant which is the food of the South Indian silkworm is known locally by different vernacular names. In Tamil it is known as '*Thippal naval Chedi*,' in Telugu as '*Kamblichettu*,' in Canarese as '*Ippunirle*' and in Hindi (Berigai) as *shāl-hōoth jad.* Unlike other parts of the world, where for silkworms the mulberry plants are allowed to grow into standard trees, here in India the plant is propagated chiefly as a bush. Although the method of growing trees is said to be better in many ways, the bush system appears to be followed perhaps to suit the *polyvoltine races* of silkworms raised in India. Numerous local

varieties of the plant are known among ryots under different vernacular synonyms which are very often confusing and misleading. It is highly probable that all these are only cultivated varieties of the one species, *Morus, alba* variety *indica*, which according to DUTHIE is the species chiefly grown all over India to feed silkworms. The selection and preparation of the soil, manuring and the various other details in connection with the cultivation of the mulberry in the two localities, Kollegal and Berigai, are so different that it would be better to treat each separately. In both places the plants are propagated from cuttings. In Kollegal the mulberry grower and the silkworm rearer are in the majority of cases different individuals. In almost all villages of the taluk where silkworms are reared owners of land generally set apart a portion for growing mulberry and later on sell the foliage to silkworm rearers. At so much for the area according to the quality of the crop the owner of the mulberry crop allows a silkworm rearer to pick leaves for one season, with the condition that the amount settled should be paid before the picking is finished: or the contract is often for paying the amount in weekly instalments in advance. The soil generally selected by the Kollegal ryot is neither of the best kind nor of the worst quality: dry lands of indifferent quality are commonly selected. The best lands are always reserved for food crops. Both red and black soils are made use of, though the opinion is that the plant grown in red sandy loams gives foliage of excellent quality. A sixth of the arable area in this taluk is under mulberry—the area for the fasli 1319=1910-11 being 10,928 acres. Of the four or five varieties of mulberry known in the taluk such as 'Raja gaddi,' 'Butha gaddi,' 'Kari gaddi,' Ennerangan gaddi,' etc., only two are popular, viz., *Butha gaddi* and *Enncrangan gaddi*, and of these the latter is extensively cultivated; but there is a lot of confusion between these, and even in the fields they are often found mixed up. The land selected is prepared for the crop during the summer months and the planting is done soon after the first rains. The preliminary operations consist of ploughing the land three to six times at intervals and mixing up manure with the soil during the last ploughing. The manure generally consists of farmyard and village refuse. As many cartloads of manure are applied as one could afford or spare for this crop after reserving the required quantity for his food crop fields. Generally from 3 or 4 to 10 or 12 cartloads are applied to mulberry lands for each acre. Soon after the first rains planting is done. One man with a plough makes furrows and in these furrows men and women make holes at distances of 3 or 4 feet apart each way and put in two or three cuttings in each hole. Mature mulberry stalks for making cuttings are generally got gratis from old plantations where the annual pruning of plants goes on at this time. From 4 to 6 good headloads of mature stalks are used up by the Kollegal cultivator to plant up one acre with cuttings. The stalks are cut into pieces 8 or 9 inches long and two or three are put in each hole. The majority of the mulberry growers in Kollegal put the cuttings flat in the holes and cover them completely with soil like sugarcane cuttings. I am told that the ordinary method of planting is resorted to only when it is done at other seasons and in gardens where there are good facilities for irrigation. In this taluk the mulberry crop is raised purely as a rain-fed crop. When the rain fails for a few days after planting, the cuttings are given a watering or two by water being carried in pots.

POULTRY.

POULTRY KEEPING IN CEYLON.

BY "BLACK ORPINGTON."

Some years ago I kept poultry with rather more than average success in Ceylon, since when I have been away in different parts of the world, returning about the commencement of the war. I was agreeably surprised to find the poultry industry had apparently (I say apparently with an ulterior motive) made great strides; there were more experts in evidence, a club was well supported, which had its own journal. Now, after looking round carefully for 18 months, my own personal opinion is that the local poultry industry is little better (if any) than it ever was. The "man in the street") (or rather, on the estate), "keeps" poultry in every sense of the word—the poultry do not help to keep him. The "experts" are, after all, very few and far between, and are mostly in the business for what they can get out of it. In these strenuous days, they need not necessarily be blamed for this, but their point-of-view is apparently that to assist the poultry industry all they need do is to sell settings of eggs and birds at quite a good price to the tyro—and when the tyro has killed his birds by injudicious management, well, he can buy some more! How often do we see the local expert's name or initials at the foot of an instructive poultry article, either in the newspapers or the Club's journal? Never! The Ceylon Poultry Club Magazine consists monthly of 12 pages of assorted advertisements and clippings from Home papers, and is but of little use locally. The clippings from Home papers are useful—but not to Ceylon. For instance, we read in the December 1915 Number that "We have reached the season of fog, damp, rain, and cold. And likewise the time when eggs are bringing splendid prices." The Editor, who is a man of vast experience and knowledge, obviously took this (and many other items) from "Poultry," quite regardless of the fact that December-January are usually reasonably dry in Ceylon, and that the average price of fresh eggs here hardly varies at all! Surely there are members of the Poultry Club with sufficient knowledge and time to write useful articles of general interest, applicable to Ceylon conditions, by the help of which the beginner can make his poultry a source of profit and pleasure?

But my purpose is rather to point out that just now poultry-keeping is a national necessity throughout the Empire. Every household should possess from 20 to 100 fowls as time and space allows, and having them, they should learn to make them pay. Not perhaps to return a profit of so much per cent. on outlay, but to enable the householder to supply himself and family with sufficient eggs and birds for eating, to the end that he may rely less on imported luxuries.

My second reason is to supply some of the hints most useful to those who "keep" fowls.

Where most people go wrong is in feeding. Nearly all give too much, some give too little, and practically every amateur gives the wrong kind of

food. To take the first. Many people have told me that 30 or 40 hens give them only two or three eggs per day, and they are "fed up." On enquiring how they feed them, the reply is invariably, "Oh, I let them out to scratch most of the day, and give them plenty of paddy." Now there is no egg-forming material in paddy; if you shut a hen up so that she gets no other food, and feed her on paddy only, she will lay no eggs at all, and these 30 or 40 hens that are let out daily manage to lay a few, because they get at other food—and some of those eggs are probably laid in places that only the hen and the garden cooly know of, so down goes your average yield some more.

Firstly, give your hens as good an enclosure as you can manage. Waste land on which there is low scrub which can be partially cleared is as good as anything, and a plot of about 12 to 15 yards square will comfortably accommodate 15 fowls and require very little digging and liming. If fowls are crowded, the soil gets sour, and requires lime well dug into it two or three times per year. The same number of fowls require a well-ventilated house four feet square, larger if convenient. House should be wooden, tarred, with earth floor, well hammered down, with perches not more than 12 inches above the ground. A better house would be that with mud walls and wooden roof, but the wooden house has the advantage of being removable to fresh ground if required. Do not use tagrum for house or roof, as it causes tremendous changes in temperature between coldest and hottest hours of the day and night.

FOOD.

Make up your mind to cut out practically all paddy, giving it only as a change now and again. Indian corn give only in cold, wet weather, and then not too freely, as it causes over-fatness. A fat hen can *not* lay eggs.

For the morning feed give a hot mash of poultry meal, in which may be included with advantage, every other day, one-quarter part good bran. Put the bran in a bucket first, sealed with boiling water, and add the meal, mixing to the consistency of a crumbly paste. In this mash include all the useful kitchen scraps, minced or chopped fine, boiled cabbage leaves, potato peels, etc. Let the fowls have this one hour after they are let out in the morning, and give them as much as they will eat readily, but no more.

The mid-day meal should be very light, and can be omitted entirely if the fowls have ground containing good green food or piles of litter such as dead leaves, in which they find food. In any case, give only a few handfuls (3 handfuls to a dozen fowls) of grain, well scattered.

For the evening meal wheat or good oats are the best possible, and the birds should have as much as they will eat one hour before roosting. Really good heavy oats are difficult to get in Ceylon, and very expensive, but no harm will result if wheat is fed only for the evening meal. Give paddy one or two evenings a week if you wish, as it reduces the food bill. On wet, cold evenings a reasonably good plan is to start with wheat, then paddy, and after the paddy give as much as the fowls require to fill up of Indian corn. They will not have had as much of the latter as will put on fat, while sufficient will be given to warm them up nicely for the night.

There is no golden rule as to quantity per head. The best maxim is to never give full grown fowls all they will eat except at the evening meal; after all other meals they should be ready to scratch for what can be found.

Green food is essential for fowls, and if none is growing in their enclosure, it must be supplied. Lettuce is excellent raw, but cabbage leaves and other coarse vegetables should be boiled.

Clean, cool water should be at hand. See that the water vessels are kept clean, in a shady place, and replenished two or three times a day. It is an excellent scheme to put a few crystals of permanganate of potash in the water, as this acts as a prevention to illness. Another useful dodge is to put one ounce Epsom salts to the morning food of each dozen fowls one day per week, whether they want it or not.

If you have space on which to let your fowls out of their usual enclosure, it is well to do so daily. Let them out at 3·30 p.m., and they will come in for their evening feed at 5. This gives them a change of ground, an interest in life in searching for food, and somewhat cuts down the corn bill. If fowls are to be kept successfully, you must aim at keeping them active and interested. A lot of birds that move listlessly around the place waiting for the next meal time will invariably be found on enquiry to be a dead loss to their owner.

Do not let the fowls out until 3·30 as by then they will have finished laying for the day.

The above indicates somewhat briefly the general lines on which I have kept fowls for some 16 years. Probably I have possessed something over 5,000 birds in that time. I do not believe twenty of them have died of illness, and every year of the sixteen has shown a handsome balance of profit.—TIMES OF CEYLON.

THE SECRET OF SUCCESS.

The good gardener is he who has a beautiful garden, even if he grows only the easiest plant in it. For it is never easy to have a beautiful garden. You cannot do it if you want to excel others in growing difficult plants, or if you are eager to follow the latest fashion in garden design, or if you care more for the names of plants than the plants themselves. That wonderful gift which some gardeners seem to have for growing anything is no magic; it comes from the love of plants. They think of their plants more than they think of themselves. And that other gift for making a garden beautiful is no magic either. It comes of loving the garden as well as the plants. If your garden is to be well designed, it must be a part of your home to you and not merely a plot for growing plants in. You must regard it as a place to live in and not as a place to show to other horticulturists. Those who would be good gardeners should learn to enjoy their gardens and not merely other people's praise of them.—THE TIMES.

AGRICULTURAL EDUCATION

SCHOOL OF TROPICAL AGRICULTURE.

TEST EXAMINATION.

The following are the questions and results of the first Intermediate Test Examination of the School of Tropical Agriculture held at Peradeniya on Monday 27th March and the 3 days following.

The Examination consisted of 8 written tests, made up as follows:—

(a) four major papers with a time limit of 1½ hours and a maximum of 150 marks, each paper consisting of 5 questions.

(b) four minor papers with a time limit of 1 hour and a maximum of 100 marks, each paper consisting of 4 questions.

The major papers were set on the following subjects:—Economic Products, Chemistry, the Soil, the Plant.

The minor papers were:—The Animal, Co-operation, Crop Pests, Agricultural Engineering.

The maximum of the examination was 1,000 marks.

ECONOMIC PRODUCTS.

1.—What do you understand by the term "fruit?" How should choice varieties of fruit trees be propagated?

2.—Edible fruits may be divided into two main sections. Describe these briefly and give examples.

3.—Mention what in your opinion are the 3 best and most suitable fruits for each of the following localities and state briefly what you know about each kind:—

A. Dry region, as Jaffna or Anuradhapura
B. Wet region, as Kegalle or Ratnapura
C. Up-country, as Hatton or Nuwara Eliya.

4.—What is the best variety of Pineapple grown in Ceylon? State the points in its favour and how you can distinguish it from others.

5.—Write a short descriptive note on each of the following spices:—

A. Cinnamon
B. Cardamom
C. Cloves.

Report of Examiner:—

42 per cent. of the students passed in this paper.

(Sgd.) H. F. MACMILLAN.

THE ANIMAL.

1.—Into what divisions is the animal body divided for the study of its anatomy?

2.—Name and compare the different kinds of diathrodial (movable) joints.

3.—Make a diagram of the alimentary canal, indicating thereon the different parts beginning with the mouth.

4.—Describe the functions of the Reticulum (or first stomach) and state its functions.

ENGINEERING.

1.—Describe a Gunter's chain. What errors is the surveyor liable to make in using this chain?

2.—How is a chain survey executed in easy open country and why? Illustrate your answer by a plan.

3.—How would you find the area of a triangle, having been given its three sides?

How would you modify this in the case of equilateral isosceles, and right-angled triangles?

4.—(a) How do you construct a right angle with the help of a chain alone?

(b) How many sq. links, sq. chains, sq. yards make an acre?

(c) Define :—base line, off set, surveyor's cross.

(d) What is meant by drawing a plan to scale? Illustrate your answer with a diagram.

REPORT OF EXAMINER :—

The papers were corrected from the standpoint of matter and not language. The students require some practice in answering question papers. In many cases their language does not express what they mean.

(Sgd.) W. P. A. COOKE.

CO-OPERATION.

1—What were the first four systems of Co-operative Credit Societies? Describe them.

2.—When and how were Co-operative Credit Societies recognised by the Government in Ceylon?

3.—Give a short description of the constitution and management of a society as far as you understand them from the Ordinance.

4.—Name three advantages conferred on these societies by the passing of the Ordinance.

REPORT OF EXAMINER :—

Only six students failed to obtain pass marks.

(Sgd.) N. WICKRAMARATNE.

CHEMISTRY.

(Diagrams illustrating answers will enhance their value.)

1.—Describe two synthetic and two analytic methods of determining the composition of water. What Gas Laws are illustrated by the reactions of steam?

2.—Give some example of the importance of water in the economy of nature.

3.—Give a list of ten of the more important chemical elements, tabulating the following details regarding each (1) Atomic weight. (2) Symbol. (3) Character. (4) Two well known compounds.

4.—Define:—Acid, Alkali, Salt, Base, Indicator. Give three reactions of acids with bases (with equations) showing the products of the reaction.

Carbonic acid is a di-basic acid. Explain this statement and give the structural formula of carbonic acid.

5.—Explain briefly the process used in the manufacture of sulphuric acid.

"Sulphur and its compounds are of great agricultural importance." Substantiate this statement, giving the uses of sulphur and two of its compounds.

REPORT OF THE EXAMINER:—

28 candidates (50%) obtained pass marks. The examination has revealed one very noticeable feature: those who came to the school course with no knowledge of Chemistry have, with one exception, done better on the whole

than those who have had previous laboratory experience. The first place too was gained by a student who had done no previous work in the subject. I think this fact may be explained partly on the ground that those who were new to it worked more eagerly on a fresh subject, partly perhaps because those who had done earlier work in Chemistry had vainly deluded themselves that they already knew all that it might be necessary for them to know, and so put in less work on the subject than was needed.

The results of this examination have also disclosed the hard workers among the students.

Among the 28 failures are 6 who have been interrupted during the course by illness.

(Sgd.) St. L. H. De ZYLVA.

CROP-PESTS.

1.—Describe briefly the metamorphosis of Insects (a) Complete Metamorphosis (b) Incomplete Metamorphosis.

Which orders of Insects belong to each section?

2a. Give the distinctions by which one may determine whether a given insect is a beetle or a bug.

b. What kind of insecticides are mainly used in destroying bug-pests and why are they used for this purpose instead of other kinds?

3a. Give a list of the orders of biting and chewing insects.

b. Give six main ways in which these insects work.

4a. Give the main divisions of the Order Orthoptera. Which of these are pests and which are not?

b. Give the characteristics of the Order Hymenoptera.

Report of the Examiner:—

Five candidates obtained over 70% marks. 17 candidates (30%) failed to obtain pass marks.

(Sgd.) G. M. HENRY.

SOILS.

1.—Describe the action of water in the formation of soil.

2.—Make a general classification of *rocks*, giving examples.

3.—Define Soil and Subsoil, and explain the terms texture, structure, specific heat, and hygroscopic power as applied to soils.

4.—What are "alkali" soils and how are they formed? Name some plants found growing in them and mention their peculiarities.

5.—Give directions for taking a soil sample for analysis.

Report of the Examiner:—

15 candidates (27%) failed to obtain pass marks.

18 candidates (30%) obtained over 50% marks.

(Sgd.) G. E. J. HULUGALLE.

THE PLANT.

(N.B.—Freely illustrate your answers with diagrams.)

1.—Describe, giving examples, the various kinds of roots with which you are acquainted.

2.—How is starch produced, and how is it transferred and stored away in plants?

3.—Write brief notes on (a) the structure, (b) formation, and (c) uses of:—(1) stomata, (2) root-hairs, (3) laticiferous vessels, (4) oil glands, (5) esin passages.

4.—Explain the terms hypogyny, perigyny and epigyny. Which condition do you consider most advantageous, and why?

5.—Classify and describe six fruits that you have studied.

REPORT OF THE EXAMINER :—

The table shows that 50% of the students who stood the examination have satisfied the examiner.

Considering that on "The Plant" the students had 2 or 3 times the number of lectures they have had on other subjects, it is not surprising to get 50% of failures. I have hopes of the first 17 failed candidates doing better in the next inter-examinations.

At present the mass of facts studied and noted have got the better of them. The answers plainly show an incoherent and confused grasp of facts.

It is hoped that the lectures in the next season according as they recapitulate and amplify facts already studied will within their application to agriculture give them the power which is the desideratum of such studies.

With a few exceptions, all questions were attempted. Most students got mixed up in their answers to the last question.

Questions 1 and 4 were answered best.

Answers to question 3 were disappointing and brought home very forcibly to the examiner the necessity for some sort of microscopic work that will help to catch and fix what are now rather hazy ideas.

Question 2 was not answered so well as the examiner expected that it would have been.

(Sgd.) HENRY L. VAN BUUREN.

RESULTS OF EXAMINATIONS.

List of names of students who passed in all subjects :—

Order.	Names.	Percentage of Marks.	Order.	Names.	Percentage of Marks.
1	Mendis, M. S.	72	8	de Silva, R. E.	62
2	Jackson, J.	71		Orr, C. E. M.	62
3	Kurien, E. K.	66	10	Pieris, H. C.	59
	Pereira, B. A.	66	11	Perera, V. G.	57
5	Ludowyk, J. H.	63		Bibile, C. W.	57
	Kapuwatte, P. B.	63	13	Kotani, T.	55
	Dias, A. E.	63		Van Reyk, B. E.	55

REPORT ON EXAMINATIONS.

Fourteen candidates passed in all 8 papers: eight candidates in 7 papers only; nine in 6 only; seven in 5 only; three in 4 only; ten in 3 only; one in 2 only and four in 1 only.

No student failed in every paper of the examination.

Eleven students were absent from the whole examination.

Of the 56 students who sat for the examination, 39 passed on the aggregate, making 70 passes per cent. approximately. These results are gratifying.

The Pass List (aggregate) contains the names of 14 students who passed in all the 8 papers, and of 25 students who failed in one or more papers but passed on the aggregate.

(Sgd.) ST. L. H. DE ZYLVA,
Registrar, School of Tropical Agriculture.

Peradeniya, April 14th, 1916

CO-OPERATION.

ADVANTAGES OF CO-OPERATIVE CREDIT SOCIETIES.

The majority of the inhabitants of a village are cultivators; the rest are traders, carpenters, weavers, smiths, potters, or follow other occupations. They all require capital or ready cash to carry on their work. The farmer needs it for buying manures, draft-cattle, ploughs and for paying the labourers engaged in watering his tobacco and other crops or for sinking a well. Money is required by the trader to buy his stock in trade; by the carpenter to purchase materials and tools; by the weaver to buy yarn, etc; by a smith to procure metal wherewith to manufacture various articles, and so on. No one will gainsay the fact that money is the prime necessity for making any progress in his business and that without it very little can be accomplished. It is not every one in a village who possesses sufficient ready money for meeting his requirements. Indeed there are very few who are able to meet their outlay from their own resources. One point is clear, that those who have no ready money must borrow from lenders of money. It is no discredit to borrow money since most of the transactions in the world are carried on with borrowed capital. But what one should consider before he borrows is what interest he has to pay. As a rule the poor man has to pay a higher rate of interest than the rich man. The fact is the poorer the man the higher the rate of interest he has to pay. Why? Because the poor man has no facilities for approaching the money market, while the man in good circumstances has; because the poor man is given no credit as he has no visible security while the man of means gets it because he can give security and therefore enjoys the confidence of the money market. A poor villager is unable to obtain a loan from a big bank, while the man of property enjoys this privilege. The poor man has, however, one medium through which to approach the money market, and he has one asset he can utilize as security. This asset is his good character and the medium is a Co-operative Credit Society. This is just where a Co-operative Credit Society can come to the poor man's help. A Co-operative Credit Society registered under the Ordinance is a means through which the poor man can find his capital on as easy terms as the rich man is able to procure his from a big bank.

So it will be seen in the first place that Co-operative Credit Societies enable the poor man to obtain a loan on low interest. The society can raise loans and its members can get loans from the society. The affairs of the society are in their hands and they can fix the rate of interest chargeable to members. If the rate of interest charged by the money lenders in a village is 24 per cent. per annum (that is two cents per rupee per mensem) the society's rate may be fixed at 9 or 12 per cent. per annum (that is $\frac{3}{4}$ of a cent or one cent per rupee per mensem.)

The interest paid to the society belongs to the members themselves and any profit made by the society is theirs also.

A society is not only a medium for obtaining loans, but also a medium for banking one's savings. Therefore the object of a village society is two-fold: (1) to provide a means by which money can be borrowed at a lower rate of interest than that now charged by professional money lenders and (2) to teach the villager how he can save some money for himself.

Every villager can save something out of his crop or earnings and those savings, no matter whether it is a few cents or a few rupees, may be deposited with the society in the same way that one may deposit his money in a Post Office Savings Bank and he will receive interest for such deposits. The society mav pay interest on such deposits at the rate of 2 or 4 per cent. per annum. Money deposited may be lent out at a higher rate of interest to members thereby bringing more profit to the society. So a society in a village provides the members with a sort of bank from which to borrow money and also a safe place in which to deposit money in the same way that a town bank serves the richer classes. It does more than that. It encourages members to be economical and inculcates thrift. Only persons of good character are eligible as members. As the society is managed by themselves, members learn business habits and receive a training in the control of money and in the keeping of accounts.

The office bearers and the Committee will see that the society's work is carried on according to regulations. The society's accounts are audited annually by a Government official. A Co-operative Society like other business co-operation is not required to pay any fee to Government for its registration and the instruments executed by or on behalf of a society are exempted from stamp fees and registration fees. Every facility is given by Government for carrying on the work of a society. This is not all, for Government is prepared to lend money on very low interest, (say 4 or $4\frac{1}{2}$ per cent. per annum) to the approved societies to be repaid in small instalments extending over to a number of years.

A society should have a reserve fund to meet unforeseen losses. This is formed by placing to its credit a small proportion of the profits of the society.

As all the office bearers work gratuitously, there is no expenditure on the working of a society excepting such minor expenses as stationery, which may be met from profits.

Benefits and advantages accruing from a Co-operative Credit Society cannot be described in a small leaflet like this. Such a society can be adapted to meet various purposes and may term as credit societies, supply societies, societies for the disposal of produce, cattle insurance societies, etc.

A word about the money lender and the wealthier class of people or leaders may be said here. They may entertain objections to joining a society of this nature and ask what benefits they will derive from it. Now to begin with, it may be stated that every code of morality teaches us to help the poor, and this thought should weigh with the man of means. But at the same time they must not consider that these are charitable institutions. On the contrary they are established on a sound business basis. Another point to remember is if the better class people do not take the opportunity of joining these societies at first they will be left behind and those who succeed in launching

a society, will get on with their work without them. Men of position and money lenders can help societies in two ways. Firstly they may give their personal assistance by advising and leading them in the proper path and secondly by depositing their money on interest in these societies. Thereby the society is benefited, the members are benefited and they themselves are not losers. They get interest for their money and a good name for their assistance. If not, when the villager can borrow money at low interest from the society he will not come to the money lender to borrow on high rate and so the money lender will lose his customer.

These societies are not new societies though new to Ceylon. They have been established in every European state. There are thousands of societies in India too.

According to 1913-14 figures there were in the Madras Presidency alone (just on the other side of the sea) 1,333 societies with 105,537 members and a working capital of Rs. 12,320,186. The total number of societies in India in the same year was 16,158 and the number of members stood at 777,604. The working capital was Rs. 80,190,779·00. This will show what progress they have made in India during the last 10 years as these were first established in India in the year 1904.

In Ceylon we have so far 55 societies : out of these nearly 50 are in working order. The membership of these is 4,812 and the paid-up capital is nearly Rs. 25,000/-. Ours is a new movement and when the people come to understand the benefits and advantages of the societies, and when they learn their working and begin to have confidence in it, we hope to have a society in almost every village, and to find every villager a member of his own society. Thus we shall be helping out the cultivator from his present helpless state, save him from the usurious money lender and make him a happy and contented man.

Any information on the working of a society can be obtained from the Registrar of Co-operative Credit Societies or the Secretary, Board of Control, Co-operative Credit Societies, Department of Agriculture, Peradeniya.

N. WICKRAMARATNE,
Secretary, Board of Control,
Co-operative Credit Societies.

Peradeniya, 31st March, 1916.

CO-OPERATIVE CREDIT SOCIETIES AND MANURE FOR PADDY.

Very few are aware that a large quantity of bone manure is used by the ordinary paddy cultivators in the low country villages for their paddy crop. In the usual way the villager would either purchase his bone manure for cash from the village boutique keeper by paying 20 per cent. or so more than the cost price or buy on credit to give paddy in kind after the harvesting of the crop which when sold would produce money valuing 50 per cent. or so more than the cost price of manure.

Since last year a commencement has been made by some of the Co-operative Credit Societies to utilize their worth in the co-operative purchase of bone manures and sale among their members with some satisfactory profit to societies and great convenience to members. Twelve of the societies have received during "Yala" and "Maha" seasons in 1915, and "Yala" season in 1916, eighty one tons and four hundredweight of bone manure costing Rs. 8,449·17. One society has purchased manures for coconuts and another society for tea, indicating the interest taken by the villager in the manuring of other crops than the paddy, which was once considered the only crop manured by him.

N. W.

METHODS OF PLANTING POTATOES.

There are various methods of planting, according to the nature of the soil. In a light soil, which is easily worked, the general practice is to make holes with a stout setting peg, about 6 inches deep and 2 inches to 3 inches in diameter, and after carefully dropping in the sprouted tubers to push soil in with the feet. Another method, suited for a heavy soil is to draw deep furrows with a hoe and to push the tubers in the bottom, covering them with the feet or a rake. Yet another plan, which is suitable for a heavy soil which has been dug in the autumn, is to fork the soil loosely and plant as this work proceeds. This is an excellent plan, as it leaves the soil quite loose over the tubers—a condition especially suited to potatoes. The plan is to fork the soil to a depth of 6 inches to 8 inches until there is space for a row to be planted. The line is set and the soil drawn from it with a spade to ensure the tubers being planted at a uniform depth of 6 inches. Forking is continued after the tubers are placed, these being covered as the work proceeds. When there is again sufficient ground dug another row is planted, and the method is continued throughout the plot.

For early varieties the rows may be 20 inches apart, and the tubers 9 inches apart in each row. Good early varieties are May Queen, Midlothian Early, Sir John Llewelyn, and Ninety-fold. The potato is a useful crop for planting on waste land which had recently been cleared.—THE TIMES.

THE CEYLON

STATEMENT OF RECEIPTS AND PAYMENTS FOR

RECEIPTS.	Rs.	Cts.	Rs.	Cts.
To Cash in Hand of Secretary 31st Dec., 1914.			30	
,, Stamps in Hand, 31st Dec. 1914.			58	49
,, Members' Subscriptions.				
Local Subscriptions for 1911	8			
do 1912	32			
do 1913	233			
do 1914	908	50		
do 1915	5417	90		
do 1916	282			
,, Foreign Subscriptions	7708	58	14589	98
,, Government Grant (including one Quarterly Instalment for 1914)			36250	
,, Interest			179	36
Forward			51107	83

PAYMENTS.	Rs.	Cts.	Rs.	Cts.
By Balance at National Bank			334	84
,, General Expenditure:—				
Organising Vice-President	3000			
Assistant Editor	999	96		
Proof Reader	240			
Clerks and Peons	5414	60		
Agricultural Instructors	5601	72		
Stationery	411	77		
Postage and Telegrams	2057	95		
Office Furniture	40	13		
Bank Charges and Commission	100	60		
Miscellaneous Petty Expenses	2117	20		
Printing	186	09		
Auditors' Fee for 1914	200			
Year Book	1023	14	21393	16
Carried Forward			21728	

We certify that we have prepared this account of Receipts and Payments from the books

Colombo, 11th April, 1916.

AGRICULTURAL SOCIETY.

THE TWELVE MONTHS ENDED 31st DECEMBER, 1915

PAYMENTS.			Rs.	Cts.	Rs.	Cts.
Brought Forward					21728	
By Travelling Expenses						
Secretary and Staff			2296	94		
Agricultural Instructors			3966	69		
Special Officers			361	81		
Organising Vice-President and Staff ...			173	33	6798	77
,, Tropical Agriculturist & Journal of C. A. S.						
Printing English Magazine			6522	60		
,, Tamil Edition			200			
			6722	60		
Less Received for Advertisements ...			3100	48		
			3622	12		
Cost of Singhalese Magazine						
Editor's Fee	470	...				
Printing, and other charges ...	932	...				
	1402	...				
Less Subscriptions and Advertisements	952	30	449	70	4071	82
,, Agricultural Show Expenses:—						
Cost of medals					9	75
,, Experimental Gardens:—						
Paddy and Tissa Grass			32	65		
Bandaragama 200/-, Kegalle 184/30 ...			384	30		
Balangoda 195/-, Badulla 45/			240			
Jaffna 37/50 Tobacco Plot 37/50			75			
Nikaweratiya and Hettipola 111/75, and Ambalantota 172/75			284	50		
Mediwake 100/-			100		1116	45
,, Apiculture					1	50
,, Seed Store at Government Stock Garden:— Coolies' Wages and Miscellaneous Expenses					319	33
,, Sericulture Experimental Farm:— Sundry Expenses					195	
,, Agricultural Implements					46	55
,, Seed Supplies:—						
Excess Purchases over Sales	Purchases.	Sales.				
Vegetable Seeds	343·29	403·03				
Paddy	184·67	34·00				
Grafted Plants	956·27	1095·23				
Tephrosia Candida	45·22	36·97				
Lucerne	25·50	36·77				
Potatoes	441·36	240·60				
Coffee	3·50	2·20				
Mangosteens	15	10·44				
Sundries, Including Betel Cuttings Fern Balls, etc.	221·59	210·23				
	2236·40	2069·47				
Excess Purchases		166·93			166	93
,, Stock of Stamps					23	91
,, Balance at National Bank					16629	82
				Rs.	51107	83

cf the Society and that to the best of our belief it is correct.

FORD, RHODES, THORNTON & Co.,

Chartered Accountants.

GENERAL.

TO THE EDITOR, TROPICAL AGRICULTURIST.

DEAR SIR,

I enclose an extract from the DAILY MAIL of 13 December, 1915, about the Soya Bean*

In 1909-1910 I tried to get the villagers of Dumbara to grow the lima bean and bring in for sale to the Kandy market. It grew very well in Dumbara and when I left Ceylon in April 1910 there seemed to be some prospect of a successful result to my efforts in this direction. But I suppose since then interest in the subject has evaporated and probably nothing is now doing.

I should be glad to hear of any progress that is being made with either the Soya or Lima.

Yours truly
J. P. LEWIS
(Late G. A., C. P.)

Quisisana, Walton-by-Clevedon,
Somerset.
21st February, 1916.

LUCERNE.

J. H. GRISDALE.

Lucerne is another name for Alfalfa. It is a leguminous plant just as are peas, beans and clovers. Plants of this family are all rich in protein.

Alfalfa is perennial, that is a plant capable of living many years under favourable conditions. It is upright and branching in its habit of growth, the mature plants varying in height from 1 to $3\frac{1}{2}$ feet. Its leaves are three parted, the leaflets being narrowly oblong in outline. Its flowers are purple, and are arranged like those of the vetch rather than as those of the clovers. It sometimes produces seeds in Canada in small quantities.

The stem is rather woody, which characteristic develops very rapidly as maturity approaches. The leaves are attached by slender stems which become very brittle when the somewhat matured plant is dried.

The roots penetrate deeply into the soil. It has a tap root which has been known to go to great depths where the subsoil was permeable.

The rootlets bear nodules which enable it to secure its nitrogen supply from the air. The young plant consists of a number of low branches springing from a simple basal stalk at the crown of the root. These branches ascend directly above ground and form a compact tuft. On the old plant, however, certain of the more robust stems elongate underground and become new branch-producing stocks.

In this way the simple stock or rhizome becomes two or many-headed.

* Not reproduced.

SOILS.

As just stated, alfalfa is a deep-rooted plant, hence in considering soil suitable for this crop the character of the subsoil must always be of primary consideration. Two qualities are absolutely necessary in the subsoil for an alfalfa crop to succeed. It must be well drained to a depth of at least 2 feet, and it must be possible of penetration by the roots of the alfalfa plant to a similar or greater depth.

Any field likely to be under water, or the soil saturated with water at any time for more than thirty-six hours at a time, is quite unsuitable for alfalfa. Any field with a hard-pan subsoil within two feet of the surface will prove unsatisfactory for alfalfa.

The most suitable soil conditions for securing a good stand of plants and securing good and continuous crops afterwards, are a light sandy loam in good heart over a deep loose alluvial subsoil.

A subsoil rich in plant food is of course very valuable, but, while fertility in the subsoil is important, permeability is still more to be sought after. A sandy subsoil while not in itself so rich in plant food is likely to give much better results than a clayey subsoil under a similar surface soil. Upon the fertility and physical condition of the surface soil more than upon any other factors depends the success of the first year. The success or failure of later years depends in a great measure upon the subsoil.

SOIL PREPARATION.

To insure a good stand three conditions are necessary in the land selected:—

1. Freedom from weeds.
2. Excellent physical condition or tilth.
3. Abundance of plant food.

Freedom from weeds may be secured by sowing immediately after a hoed crop as potatoes, corn or roots, or by sowing after a complete or a partial summer fallow. Clover sod, stubble, or even old meadow ploughed shallow in August, rolled and cultivated at frequent intervals during September, and receiving proper treatment in October, may be expected to give good results. In October it should be ploughed again with a subsoiler attached to the plough, or ploughed with two ploughs, one without a mould board following in the track of the other, and stirring the subsoil as much as possible, or cultivated lengthwise, crosswise and angling with a strong stiff-toothed cultivator, to be followed by a double mould board plough, leaving the whole field in ridges about 7 inches high and 22 inches apart.

Such treatment insures a seed bed permeable to early roots, fairly rich in plant food, and in excellent physical condition. The latter condition is insured by the retention of the humus or decayed vegetable matter (roots, fallen leaves, etc., of previous crop) in the surface soil, and by the facilities for drainage afforded by the ridging of the surface soil and consequent exposure of the upper subsoil to the effects of the frost.

In the spring as early as possible the proposed alfalfa field should be prepared for seeding. The preparation should consist of frequent cultivations, harrowings and rollings until the seed bed is perfectly smooth and mellow.

SOWING THE BED.

Alfalfa may be started successfully with a nurse crop. Where preferred it may be sown alone. In either case, a liberal seeding of good germinable seed is necessary. Before purchase a sample of the seed should be secured and tested for germination. It should show over 90 strong germinable seed to the 100. Such seed should be sown at the rate of 25 lb. to the acre. Seed showing a less percentage of germination must be sown more thickly.

Particularly strong heavy soil may be expected to give somewhat better results when a nurse crop is used. Oats, wheat or barley may be used for this purpose. It is probably better to sow somewhat less than the regular amount of grain to the acre, of the sort chosen when sowing as a nurse crop. Some growers advise about half a bushel of seed of the nurse crop to the acre no matter what kind is used, but, with climatic conditions such as maintain in Ottawa, it would not be advisable to sow such small quantities. The drier the climate the smaller the amount of seed of the nurse crop it is advisable to sow. It would seem wise to sow the usual amount of seed per acre of the nurse crop selected (oats $2\frac{1}{2}$ bus., wheat $1\frac{1}{2}$ bus., and barley $1\frac{3}{4}$ bus. per acre) for the Maritime Provinces, Quebec and Eastern Ontario; about half the regular seeding in Central and Western Ontario; no nurse crop in Manitoba nor in the North-west Territories; and in British Columbia more or less than half a seeding according to the particular district.

With light soils it is usually better to use no nurse crop, but the state of fertility of the particular field should always be considered. A light soil rich in plant food and humus would indicate strongly the use of a nurse crop.

The seed should be sown only after the field is in a state of almost perfect tilth. No cultivation, or at most very little, should be given after the seeding is done. The seed may be sown either broadcast or in drills. Sowing the seed from the grass seed spouts of the average seeder is probably the best method. The spouts should be pointing backwards rather than forward. The ground should be rolled shortly after seeding, and the surface lightly scratched with a brush harrow, a breed weeder or a tilting harrow fairly well tilted back. This latter operation is to prevent evaporation and is necessary only in dry times or in localities having small rainfall.

Any person sufficiently interested to try a small plot should prepare the seed bed thoroughly as indicated above, then sow in rows from 7 to 9 inches or further apart. Another method which we have found very successful is to sow shallow in rows about 15 inches apart and cultivate between the rows. The treatment prescribed for the first season 'without nurse crop' should otherwise be the same as for larger areas.

TREATMENT DURING FIRST SEASON.

The first summer is a critical time in the life of the alfalfa plant.

Without Nurse Crop.—Young alfalfa plants are very tender and must be given no rough treatment before they are well established, but the field must be mown and mown often during the first year to insure success. Blooms should never be allowed to appear. The crop should be cut as often as it reaches 8 to 10 inches in height. Frequent cuttings keep down weeds, aid root development and encourage growth. The clippings should, in almost every case, be left on the field as mulch. As wide cutting a mower as possible should be used and the sickle bars should be tilted to avoid cutting too close.

With Nurse Crop.—During the growing period of the nurse crop no attention is necessary. As harvest time draws on, however, careful watch must be kept to see that the young alfalfa plants are not being smothered by lodging grain. If success with alfalfa is the chief aim, no crop should be allowed to lie lodged upon it for more than a day or two. When harvesting the nurse crop the binder should be set to cut 5 or 6 inches from the ground. Shocks should not be allowed to stand for more than 2 days on the same spot, they would smother out the young alfalfa.

It is not advisable to allow live stock of any kind to graze upon an alfalfa field the first season, but it is not advisable to leave a very high growth to be crushed down by the winter snow. The best plan is to cut at a height of about 5 inches from the ground in September and then leave untouched for the rest of the season.

FEEDING VALUE.

As a feed for stock alfalfa may be used in several ways.

Pasture.—It is frequently used as pasture, and judging by our experiments here has no equal among forage plants for palatability, grazing capacity per acre, and food value. All classes of live stock soon learn to like it and thrive upon it. As a pasture for dairy cows it cannot be surpassed. Sheep thrive upon it exceedingly. Swine are very fond of it and do well upon it as a sole feed. Horses eat it with avidity and improve in condition upon such pasture. In a trial here with dairy cows it seemed to be worth much more than any of the grasses or clovers tested at the same time (red clover, alsike clover, timothy, brome grass and orchard grass).

It should not, however, be pastured too closely at any time. Such treatment would be particularly dangerous the second season. Sheep allowed to crop it closely do very great injury. Another disadvantage is that the trampling of the stock hardens the soil and slowly but surely kills out the catch.

Precautions must be taken too, where it is grazed, to prevent injury to the animals grazing. Cattle and sheep sometimes bloat when allowed to eat it wet with rain or dew. Such stock should be turned in only when the alfalfa is dry or when they have just had a feed of some other forage. Bloating occurs very seldom, but it occurs occasionally, and it is well to avoid any possibility of loss in this way. Hogs and horses are not subject to bloat.

As Ensilage.—Mixed with corn or red clover it is exceedingly valuable for making into ensilage. We have never tried it as an ensilage plant by itself. It has been so used, however, elsewhere and has given good results. In districts where wet weather usually prevails in June the conversion of the first cutting into ensilage would be the most practical way of saving the crop in palatable and nutritious form.

As Soiling Crop.—It is as a soiling crop for dairy cattle that alfalfa is particularly valuable. It makes a very rapid early spring growth and is usually ready to cut before any other green feed. It may be cut for this purpose before any blossoms appear, and will thus admit of being cut about four times in the season in this district. No other soiling crop approaches it in value as a feed for milk production.

It may also be used as a soiling crop for pigs. Where so used it may be expected to reduce the cost of producing pork by from 25 to 50 per cent. in comparison with pigs fed on grain alone.

To give the best results when used for this purpose it should be cut before any blossoms appear, even earlier than when cut to feed to cows. Feed all the pigs will eat up clean. It should be fed both morning and evening.

To summarize, alfalfa used as a soiling crop may be expected to produce from 15 to 24 tons per acre of the finest kind of green forage, most palatable, very nutritious and suitable for horses, cattle, sheep and swine.

As Hay.—It is as a hay crop that alfalfa has won fame and place in British Columbia and the United States, and it is undoubtedly possible of extensive use for that purpose wherever it can be successfully grown in Canada. Under favourable soil and weather conditions it may be expected to produce from five to six tons of hay to the acre per annum.

Alfalfa hay, well made, has no equal as a dry feed for live stock, but no other kind of hay requires as much care, skill and experience or information in the making as does alfalfa.

As the plant begins to blossom its stems begin to turn woody. Plants far advanced in the blossoming stage have very woody stems, easily lose their leaves and then make unpalatable, indigestible and generally inferior, hay.

It is evident, therefore, that to secure good results the crop should be cut at an early stage. Experience has shown the beginning of the blossoming stage to be the best time. The very best time is when about 10 per cent. of the blossoms are in bloom. It is then in its best feeding condition and will come along most rapidly for the next cutting. If the cutting be delayed not only will the hay cured be of an inferior quality, but recovery will be slow and incomplete, entailing a smaller total yield for the year than would otherwise have been produced.

THE MAKING OF THE HAY.

No more than can be conveniently handled in one day should be cut at one time. It is best to cut in the morning as soon as free from dew. Leave in the swath, or preferably shake up with the tedder at intervals till late afternoon or until the hay is well wilted, but not dry enough to lose its leaves, then rake into windrows. If rain threatens put into cock for the night and open out in the morning to finish curing. It should be cured until it will keep without heating, but not made so dry as to cause the leaves to drop off. In the curing and housing it should be handled as little as possible, as each handling means the loss of a considerable number of leaves, and the leaves are, by very much, the more valuable part of the crop.

Alfalfa hay should, if at all possible, be made without getting wet with rain. After being exposed to rain in the curing it is not worth nearly so much as for feed, losing probably half its value. The rain not only causes many more leaves to fall off, but seems to remove much of the palatability digestibility and food elements of the remaining leaves and stems.

It should be well protected when cured, as it absorbs rather than sheds rain. If stored in stacks, a thatch, a canvas, or a lapping board roof should be put on.

ITS FERTILIZING NEEDS.

Just as when sown to clovers and other legumes, both the physical condition and the average plant food content of a soil are improved and increased rather than injured or depleted by being under alfalfa for a time. Certain amounts of the chief elements of plant food are, however, removed by each crop and the application of farmyard manure in the fall at the rate of, say, 10 tons per acre every two years will prove profitable. If it is desired to supplement an insufficient supply of barnyard manure, the following dressing of commercial fertilizer per acre will most likely be found valuable: 30 lb. nitrate of soda, 300 lb. bone meal, and 80 lb. muriate of potash.

ITS FERTILIZER VALUE.

It is as a soil renovator or improver that alfalfa growing is frequently advocated. As mentioned above, however, soil in fairly good heart is necessary to get the crop started. But once started there is no doubt that it has great value as a factor in the improvement of the physical condition and in increasing the fertility of the field where grown. The roots are valuable not only on account of the plant food they supply when decomposing in the soil, but because they open up the subsoil and render it more permeable to surface water, so improving the soil very materially. Undoubtedly the long roots bring up from depths not reached by the roots of other plants much of the food required by the plant; hence the importance of such roots and the great value to agriculture of the plant that is able to produce them.

SUMMARY.

1. Sow sufficient seed.

2. Sow good seed, that is germinable seed.

3. Sow on well-prepared land in good state of fertility.

4. Sowing without nurse crop overcomes in some measure poverty of soil.

5. Proper preparation of the right kind of seed bed and careful observance of directions for first year treatment are necessary to ensure a long series of remunerative crops.

6. Before sowing be sure that a sufficiency of plant food exists in the surface soil to grow a good crop (40 bushels to the acre) of oats.

7. Do not sow on poorly drained land; 'well drained' should mean drained to a depth of at least two feet.—Bulletin No. 46, Central Expt. Farm, Ottawa, Canada.

THE IDEAL COLONY.

EXPERIMENTS IN ENGLAND WITH SMALL DAIRY FARMS.

The colony system, which the Committee regard as essential, has not been adopted to any material extent by county councils under the Small Holdings Act because of the unwillingness of applicants to sever local ties. For a State scheme on the scale suggested it is, however, necessary, if expert guidance, business organization, and the social life to which the men have become accustomed are to be provided. The Committee consider that the ideal settlement would be a village community of at least 100 families all interested in the cultivation and development of the land, but including those engaged in trades subsidiary to agriculture. In some cases the settlement may be established in close proximity to an existing village, and then the whole 100 need not be ex-Service men. In other cases it may be necessary to form a new community, and such a settlement should be designed to accommodate not less than 100 families. The minimum acreage to be taken for a fruit and market garden settlement should be 1,000 acres, and for settlement on dairying or mixed holdings, 2,000 acres.

These minima are selected because of the difficulty of getting more, but whenever enough suitable land is available in the immediate neighbourhood it will be better economy for the State to take a larger acreage. Larger areas will reduce the cost of management, and will be an advantage from the point of view of collective marketing.

The type of holding recommended for men with no previous experience of agriculture is that devoted to fruit and market garden crops. On these they can be trained more quickly and easily than in any other form of cultivation, while the initial planting could be undertaken by State and the cost included in the rent, so that the man would not have to have much capital for stocking the holding. If a holding of three acres is cultivated intensively it is as much as one man can manage without employing hired labour.

The Committee would also like to see an increase in the number of small grass holdings, which in many parts of the country are the most successful type of small holding. They suggest that some of the land at one of the first colonies should be used for a demonstration of arable dairying on holdings of 25 acres. Small mixed farms of from 35 to 50 acres, comprising both arable and grass land, with an addition to the ordinary farm crops a portion devoted to keeping a cow or two, pigs and poultry, and the growth of some fruit and vegetables, while regarded as worth encouraging, are not recommended to men without knowledge and experience.

MANAGEMENT AND CO-OPERATION.

It is recommended that each colony shall be under the control of a resident director possessing both scientific knowledge and practical experience and that there shall be a practical agricultural or horticultural instructor and occasional instruction in special branches. In each colony there should be a demonstration holding managed by the director. Co-operation in the disposal of produce is recommended, though this should not be compulsory. Facilities for the small holders to obtain the use of the larger farm implements are suggested, and also for the hire of horses and extra labour at special seasons, and for this purpose it is recommended that a certain portion of the colony should be kept in hand as a central farm under the management of the director. The Committee suggest that the War Office should hand over to the Board at the conclusion of the war some of the horses and wagons no longer required for military purposes. The central farm might also find employment at certain seasons for small holders not fully employed on their own holdings.

FINANCE.

It is estimated that the cost of the three pioneer colonies will not be more than £334,020. If the land could be leased and military hutments were available it is estimated that the cost of the three colonies would be less than £100,000. The three colonies would not be likely to provide accommodation for more than 300 families, and provision should be made on a much larger scale.

"We think," the Committee say, "that the sum which should be appropriated for the purpose in the first instance should be £2,000,000, and that this amount should be charged on the Consolidated Fund and should be advanced from time to time in such instalments as may be required by the Board of Agriculture and Fisheries. This sum should be sufficient to provide for at least four or five thousand families, including a proportion of unmarried men; but if the number of suitable applicants fell short of these figures, the expenditure of the whole amount would be unnecessary. If, on the other hand, the above figures are exceeded, such additional sums as may be required should be provided."

Emphasis is laid on the need for immediate preparatory steps if the colonies are to be equipped properly by the end of the war.—The Times.

A GREAT GARDENER.

The passing of Canon Ellacombe, after nearly a century of life, deprives the world of amateur gardeners of a personality as unique as it was remarkable. Succeeding his father as vicar of Bitton, near Bath, in 1851, Ellacombe inherited his love of plants along with the vicarage garden, and before many of the present generation of amateur gardeners had left the nursery Bitton had become the Mecca of people interested in horticulture. That it should have remained so to the present time, through all changes that have taken place in more than 50 years, is a wonderful testimony to the influence of the man and his work.

In the 'sixties, convention ruled the garden with a rod of iron; our fathers were still in the clutches of geometrical formality and hide-bound tradition, the latter usually garbed in broad-cloth and a green apron. The cultivation of hardy plants and alpines as practised nowadays was unknown; the carpet bedder reigned supreme; and amateurs with any intimate knowledge of garden plants and their ways were few and far between. That the whole artificial product of ages should have crumbled to the ground so

completely in a comparatively short time was due in large measure to the untiring efforts of WILLIAM ROBINSON and the school of thought he initiated 40 years ago.

THE RETURN TO NATURE.

No one had more sympathy than ELLACOMBE with the desire to let Nature in at the gate and banish the shams and "artistic" monstrosities with which the "landscape artists" and gardeners of the Victorian era cozened their patrons, and Bitton is a good example of trees, shrubs, and plants, forming a picture as satisfying to the eye as it is to the needs of the practical gardener.

Tucked away in the extreme south-west corner of Gloucestershire, in the trough between the Cotswolds and Mendip hills, Bitton is a typical instance of the old English parsonage, peaceful, homely and picturesque. Externally and in its general aspect there is nothing especially remarkable about the place, but once inside the gate the horticultural pilgrims become aware that here indeed is a paradise for plants.

"The Canon," as he was affectionately known to a host of friends, was more concerned with the well-being of the inhabitants of the vicarage garden than with the æsthetic appearance of the place itself; he was pre-eminently a cultivator, and had the inestimable advantage over modern gardeners that more than half a century of experience and continuity of cultivation under ideal conditions alone can bring. Hence it has come about that, notwithstanding the extraordinary high pitch to which the cultivation of plants has been brought within the last few years, Bitton remains almost unique among inland gardens, while few places similarly situated can compare with it where rare flowering shrubs are concerned.

SOIL AND CLIMATE.

It was ELLACOMBE's habit to ascribe much of his success as a cultivator to the alluvial soil and genial climate of his country, and while these factors, as well as the warm vicarage wall, had much to do with the wonderful growth of plants and shrubs, they would have counted for comparatively little if not reinforced by the knowledge, ripe experience, and sympathy possessed by the Canon. ELLACOMBE realized the limitation of his garden and wisely left the cultivation of Alpine plants to those more favourably situated than he was as regards altitude, for Bitton is but a few yards above sea level; but he was no stay-at-home, and in his regular visits to friends contrived to see nearly all that was worth seeing in the many fine gardens that have sprung into existence during the last 30 years. In the course of his life he shared in all the extraordinary changes that have lifted gardening and the cultivation of plants from the moribund condition in which they were in the 'sixties to the wonderful standard of recent years, and his influence has been all for good.

To a cultured mind ELLACOMBE added the possession of an almost unique library of horticultural and botanical works, none of which had any secrets from him; indeed, one never asked for a reference in vain. Like all true gardeners, ELLACOMBE was generous to a degree, and would have shared his last plant with anyone who coveted it. There are scores of gardens in the three kingdoms where his memory will be kept green for many a day.—THE TIMES.

THE DATE PALM IN EGYPT.

T. W. BROWN.

Date palms may be propagated by means of seed and off-shoots. A very large number of the date trees now existing in this country, especially in the Fayum and Upper Egypt, have been grown from seed which has been sown

to a great extent by chance. The system of raising palms from seed does not appear to have been practised systematically at any time on a large scale, and at the present day this method of propagation is not followed except to some extent in Upper Egypt and Nubia. It is rumoured that a large proportion of the trees which are grown from seed produce fruit of inferior quality.

The market of Upper Egyptian towns during the date season overflow with fruit of the poorest types from seedling types.

Palms raised from seed are known as *Maghal*, *Baladi*, *Shebahi*, *Mantoor*, *Masri*, *Mawa*, *etc.* The trees grown under these names in Egypt are extremely numerous and of the most varied description. Occasionally a seedling tree yields fruit of the best quality, and many of the local varieties which are peculiar to certain districts, not to speak of widespread and better known varieties, have no doubt appeared first in Egypt as seedling trees and not as imported plants from other countries.

When a first class date appears among seedling trees the proprietor often plants its off-shoots in order to reproduce the kind without variation, and after a time it receives a distinguishing name and is established as a recognized variety. Any one who makes a collection of Egyptian dates will still find fruit of a good quality included under the name of *Baladi* or *Maghal*.

The process of selection is going on yearly but slowly without any collaboration of one cultivator with another.

When palms are propagated by means of seed the latter should, if possible, be sown at the beginning of summer. The seedlings should be allowed to stay one year in the seed-bed. They are then transplanted and placed two metres apart in nursery rows where they remain until they are large enough to be planted where the trees are to grow. About half the plants are usually male, but the sex of the trees cannot be determined until they produce flowers. To insure the presence of females of fruit-bearing trees it is customary in the province of Aswan to plant several seedlings in each hole. This is one of the reasons why so many of the palms in that part of the country are standing in groups, all the stems apparently arising from the same base. Each group is called a *borá*. When the seedling palms come into flower most of the male trees are removed. In some districts palm trees are required less for the fruit than for the leaves, and seedling trees then serve the purpose quite well. Male trees and all palms which do not yield fruit produce the largest number of leaves. As will be seen later, a crop of leaves is almost always taken even from fruit-bearing trees, and where this is done in strict moderation it is the most profitable course to pursue. For certain work it is, however, necessary to cut the leaves in a young state from the heart of the tree, and in such a case it is impossible to obtain fruit in addition to the leaves.

PROPAGATION BY MEANS OF OFF-SHOOTS.

Good varieties of dates are propagated by means of the off-shoots produced at the base of the young palms. When the off-shoot is planted it very soon commences to make other off-shoots, even if it has not done this before its removal from the parent tree. Some cultivators leave the off-shoots until the mother plant has attained an age of fifteen to twenty years and then remove all the shoots at the same time.

Others remove the most advanced shoots before that time and leave the smaller ones until later. A tree cannot yield a maximum crop of fruit so long as it has a crop of suckers to support; it is therefore well to remove the latter as soon as they are ready to be planted out. Under normal conditions a healthy tree produces ten to twenty-five off-shoots at its base.

The entire group is known as a *kosha*. When these are taken away no more off-shoots as a rule arise on that tree, although in exceptional cases others may appear higher on the stem. In the garden of ISMACIL SIRRY BEY,

Cairo, there exists a tree with one off-shoot on the trunk at a height of more than eight metres from the ground. It is said that there were originally four young plants at the same point. At Gezíret Abu Rísh el Qibli, near Aswân, there are three trees, each bearing several off-shoots three to six metres from the ground. The off-shoots which arise at the surface of the ground commence rooting before they are severed from the parent stem, but there are often one or two situated higher in the *kosha* which show no signs of giving off roots. These are known as *demmil* or *tacoon* and are usually thrown away as being unfit for planting, although the soil is sometimes heaped around them until roots appear. The tool employed to sever the off-shoots from the mother palm is an iron bar with a flat end which is slightly incurved and about five to six centimetres wide. This is held by one man in the axil between the off-shoot and parent tree and the young plant severed by another man with a few blows of the mallet. In Nubia the off-shoots are usually allowed to grow on the mother tree until the young plants have stem one to one and a half metres long. They are then cut half through, bent to the ground, covered with earth and watered by hand until the young tree has produced roots. The off-shoots of different varieties of date palms vary in character, some being thick and stout, whereas those of other varieties are thin and slender.

Off-shoots are known in Arabic as *neíla*, pl. *naaiel: biz*, pl. *bezuz*; also as *shetla* and *khil'a*.

PLANTING THE OFF-SHOOTS.

Date palms may be planted at almost any season of the year. The time of the high Nile—August and September—is the most popular in all parts of the country, but more especially in the south. The temperature is then comparatively low, the atmosphere moist, and water plentiful. Next to this the spring months of March and April are looked upon as being the most favourable season for planting. The vegetative growth of the trees commences towards the end of April or the beginning of May and the off-shoot should be planted if possible before the natural season of growth begins. The cold months of winter and the very hot months of summer should be avoided if possible. For the greater part, off-shoots are planted in their permanent places as soon as they are taken from the mother palm, although they are sometimes planted two metres apart in nursery rows until they produce roots. The latter is by far the best system to follow. When planted in this way the off-shoots do not cover a large area, and in consequence can be irrigated more easily and more frequently. In this way much smaller off-shoots can be made to grow than when they are planted directly in the field. Large numbers of young plants are lost yearly owing to insufficiency of water when they are first planted. This waste of off-shoots of good varieties is very regrettable in a country where the proportion of trees of inferior kinds is so large. If more care is taken to prevent the death of young plants it will be easy to replace quickly the large numbers of poor seedling dates now existing in the country with better and more valuable kinds. Apart from this consideration, planting the off-shoots in nursery rows has the advantage of economising space for two or more years, and when the palms are finally planted in their permanent quarters the plantation comes into bearing in a much shorter time than is the case where the off-shoots are transferred directly from the mother tree to the field. On sandy land the trees are usually transplanted with naked roots, but where the soil is more compact it is better to remove them with a ball of earth attached to the roots. Young plants which have been treated in this way are known as *bint el gôra* or *mohawwal*. In the province of Aswân, the off-shoots are most generally allowed to grow into fruit bearing trees around the mother tree, and plantations are extended by means of off-shoots which are brought down the river from Saccot. These off-shoots are taken from the parent tree in Saccot in the month of February, when they are at once packed tightly together in

bundles surrounded by sacking, matting, and straw, eighteen to twenty-five suckers being packed in each bundle. When packed in this way they are placed near the edge of the river and kept wet until the month of May or June, after which they are taken by camel to Halfa for shipment to Aswân. They are watered during the voyage down the river, so that when they arrive at Aswân they are mostly well furnished with roots among the decomposing packing material. They are then graded, and those which are rooted are sold for planting directly into the field. The others are sold more cheaply to cultivators who usually plant them in nursery plots for sale during the next or following years. When removed from the nursery to the field they are dug up with a ball of earth attached to the roots.

In the Rosetta and Edku districts the off-shoots are planted on low ground where sweet water may be obtained and where the water table is near the surface of the ground. The plants are surrounded by petroleum tins, barrels, etc., to prevent the sand filling the hole. The off-shoots grow in this situation for five to ten years, even after they have commenced to bear fruit. When the trunk attains a length of two metres or more the tree is removed to high land and planted at a depth where there is sufficient moisture to enable the trees to grow without surface irrigation, the sand being allowed to fill the hole around the trunk. In this case the ground is composed of loose sand, so that the trees must be removed with naked roots.

In addition to the system of planting the off-shoots in nursery plots more artificial means are being employed in the United States to encourage the rapid development of roots on off-shoots. This is done by planting them in beds of soil with hot water pipes below. By this means plants can be caused to grow which would be too small to root in the open ground. Proprietors who possess exceptionally good varieties of dates and who wish to propagate them quickly might adopt a modification of the American system by planting the small off-shoots on beds of soil with hot stable manure below.

For planting directly in the field the off-shoots should not weigh less than three kilogrammes when properly dressed and without any external moisture. A good shoot weighs nine to twelve kilogrammes. It is more profitable to plant more moderately large off-shoots, even though they are more expensive, than to plant smaller ones, many of which die. It is specially necessary to use good sized shoots on land composed of loose sand. The larger the shoot the more deeply may it be planted, and the more deeply it is planted the less danger there is of it being moved by the wind.

To avoid the latter evil, cultivators often set the plants in a position sloping towards the north whence comes the prevailing wind. In this position the young plants do not present such a wide surface to the resistance of the wind and are less liable to injury. When growth commences, the plant soon assumes a vertical position. A shoot which is not planted well in the ground is liable to suffer from drought during the first year of its life. This of course is an important consideration where the land is sandy. On the other hand a shoot must not be planted sufficiently deeply to allow water to enter the heart and give rise to decay before growth has commenced. This often takes place in the case of trees which are planted on black land. Here, it is especially necessary to guard against planting too deeply. It is also a good precaution to put some sand in the hole around the base of the off-shoots. In low places which are subject to inundation during high Nile either very large off-shoots or trees which have been rooted in the nursery must be used. In the choice of off-shoots cultivators give preference to those which are taken from trees growing under dry conditions. Shoots of palms growing on high or dry situations root more freely than those from palms on well irrigated land. When the off-shoots are removed from the parent tree, the leaves are cut off, and as soon as the shoots are planted they are wrapped in canvas, dry weeds, or straw, to preserve the growing point from the drying effect of the sun.

DISTANCE APART.

The distance at which trees are planted apart varies between one to three qassabas (3·55 to 10·60 metres). Doubt is often expressed as to whether it is better to plant them widely apart or moderately close together. A consideration of the enormous crops which date palms are capable of yielding when growing under good conditions point to the fact that it is better to concentrate expenditure on a moderate number of trees rather than upon a larger number in the same area. The largest yield of fruit not only per tree but also per feddân is obtained in this way. The lateral roots of an adult palm are sometimes found more than seven metres from the stem and at a distance of five metres the ground is usually full of roots. It is therefore reasonable to allow the tree a space of five metres on each side for the spread of its roots without intermingling with those of its neighbours. Just as a date tree can live and grow under the most varied conditions, so its yield of fruit varies exactly according to the treatment which it receives in regard to space, manure, and water. It may grow and give no fruit whatever or it may yield a crop of 1,000 lb. or more. After a careful comparison of palms growing in different situations and at different distances apart I am of opinion that it is most profitable to plant them at a distance of not less than three qassabas one from the other.

WATERING OFF-SHOOTS.

When the off-shoots are planted in the field it is most important that the soil should be kept constantly moist. The success of an off-shoot which has been properly planted depends entirely upon this point. It is unwise to economise in the watering of newly planted shoots, as any saving of expense effected at this time will lead to increased expenditure and loss of time in replacing dead plants, not to speak of additional irrigation later when it may otherwise be decreased in frequency. On very sandy land in summer the off-shoots may require water daily, although a watering once in two to five days may suffice on better land. On loamy land which does not dry quickly there is a danger of over-watering the plants and causing them to decay before growth commences.

Less water is naturally required in winter when the ground dries more slowly than in summer. During the second year of their life in the field the trees also require less watering than during the first year.—THE AGRIC. JOUR. OF EGYPT.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Soccotrine cwt.	Fair to fine	70/ a 80/
Zanzibar & Hepatic ,,	Common to good	40/ a 75/
ARROWROOT (Natal) lb.	Fair to fine	3½d a 4d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£6 15/ a £7/
East Indian, bleached ,,	Fair to good	£8 15/a £8 17/6
,, unbleached ,,	Dark to good genuine	£6 a £6 10/
Madagascar ,,	Dark to good palish	£6 10/ a £7
CAMPHOR, Japan lb.	Refined	1/8¼ a 2/
China cwt.	Fair average quality	155/ nom.
CARDAMOMS, Tuticorin	Good to fine bold	3/6 a 4/6
per lb.	Middling lean	2/ a 2/9
Malabar, Tellicherry ,,	Good to fine bold	3/6 a 4/6
Calicut ,,	Brownish	2/ a 3/
Mangalore ,,	Med Brown to good bold	3/ a 5/3
Ceylon, Mysore ,,	Small fair to fine plump	1/9 a 6/1
Malabar ,,	Fair to good	1/8 a 1/9
Seeds, E. I. & Ceylon ,,	Fair to good	1/9 a 1/10
Ceylon "Long Wild" ,,	Shelly to good	1/ a 1/6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	110/ a 120/
Japan ,,	Fair bright small	100/ a 110/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜d a 7d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts.	Fair to fine quill	1/ a 1/9
per lb. 2nds.	,, ,,	11½d a 1/6
3rds.	,, ,,	10½d a 1/4
4ths.	,, ,,	9½d a 1/1
Chips.	Fair to fine bold	2¾d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	11d a 1/2
Amboyna ,,	Dull to fine	10d a 10½d
Zanzibar ,,	Fair and fine bright	7¼d a 7½d
Madagascar ,,	Fair	7¼d
Stems ,,	Fair	2¼d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	,,
COCOA, Ceylon Plant. ,,	Special Marks	87/ a 90/
	Red to good	80/ a 85/
Native Estate ,,	Ordinary to red	50/ a 79/
Java and Celebes ,,	Small to good red	70s a 94s
COLOMBO ROOT ,,	Middling to good	15/ a 20/
CROTON SEEDS, sifted ,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	150/ a 170/
GINGER, Bengal, rough ,,	Fair	23/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	50/ a 70/
Cochin, Rough ,,	Common to fine bold	37/6
	Small and D's	35/
Japan ,,	Unsplit	30/
GUM AMMONIACUM ,,	Ord. Blocky to fair clean	50/s a 80s
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
	,, ,, red	£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	45/ a 55/ nom.
Turkey sorts ,,	... ...	65/ a 72/6
Ghatti ,,	Sorts to fine pale	17/ a 27/
Kurrachee ,,	Reddish to good pale	22/6 a 32/6 nom.
Madras ,,	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£7 a £9
	com. stony to good block	60s a £6
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	50/ a 60/
Somali ,,	,, ,,	40s a 50s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	31s a 40s
pickings ,,	Low to good pale	15/ a 27/6
siftings ,,	Slightly foul to fine	17s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	3/4½
	Crepe ordinary to fine	3/5¼
Ceylon, Straits, ,,	Fine Block	2/4¼
Malay Straits, etc. ,,	Scrap fair to fine	2/8
Assam ,,	Plantation	1/10
Rangoon ,,	Fair 11 to ord. red No. 1.	2/3
,,	,, ,, ,,	2/2

	QUALITY.	Quotations.
INDIA RUBBER lb.		
Borneo ,,	Common to good	2/
Java ,,	Good to fine red	2/3
Penang ,,	Low white to prime red	1/11 a 2/
Mozambique ,,	Fair to fine red ball	2/11
,,	Sausage, fair to good	2/10
Nyassaland ,,	Fair to fine ball	2/9
Madagascar ,,	Fr to fine pinky & white	2/2
,,	Majunga & blk coated	1/11
,,	Niggers, low to good	1/3 a 1/9
New Guinea ,,	Ordinary to fine ball	2/3 a 2/6
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	14/6 a 15/
,,	Consuming mid. to gd.	13/6 a 14/
	Ordinary to middling	12/6 a 13/6
,,	Mid. to good Kurpah	7s 6d a 9s
,,	Low to ordinary	5/6 a 7/
,,	Mid. to fine Madras	4/6 a 6/
MACE, Bombay & Penang	Pale reddish to fine	2/2
per lb.	Ordinary to fair	2/ a 2/1
Java	,, ,, good pale	2/ a 2/2
Bombay	Wild	5d
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	1/4 a 1/6
	80's	1/
	110's	10d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20
NUX VOMICA, Cochin	Ordinary to good	22/ a 24/
per cwt. Bengal	,, ,,	21 a 22/
Madras	,, ,,	22 a 23/
OIL OF ANISEED lb.	Fair merchantable	3/3½
CASSIA ,,	According to analysis	3/11 a 4/1
LEMONGRASS oz.	Good flavour & colour	1⅛d
NUTMEG ,,	Dingy to white	1½d a 1/¾d
CINNAMON ,,	Ordinary to fair sweet	4½d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/8
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	8d
Ceylon ,, ,,	Fair to fine bold heavy	7d
Singapore ...	Fair	7¼d
Acheen & W. C. Penang	Dull to fine	nom.
(White) Singapore ,,	Fair to fine	9¾d
Siam ,,	Fair	9½d
Penang ,,	Fair	9d
Muntok ,,	Fair	10d
RHUBARB, Shenzi ,,	Ordinary to good	2/10 a 4/
Canton ,,	Ordinary to good	1/4 a 2/3
High Dried ,,	Fair to fine flat	1/1 a 1/3
	Dark to fair round	8d a 8¼d
SAGO, PEARL, large—cwt	Fair to fine	24/6 a 25/
medium ...	,, ,,	24/6 a 25/
small ...	,, ,,	22/ a 23/
Flour ...	Good pinky to white	14/6 a 14/9
SEEDLAC cwt.	Ordinary to gd. soluble	55/ a 90/
SENNA, Tinnevelly lb.	Good to fine bold green	10¼d a 11¼d
	Fair greenish	8d a 9d
	Common specky & small	5¾d a 7¾d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	50/ a £5 10/
Bombay ,,	,, ,,	60/ a £5 10/
Mergui ,,	Chicken to bold	£6 10/ a £12
Manilla ,,	Fair to good	£6 10/ a 10 10
Banda ,,	Sorts	30/
Green Snail ,,	Small to large	55/ a 75/
Japan Ear ,,	Trimmed selected small to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	23/ a 24/
per cwt. Madras	Inferior to good	Nominal.
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	10/ a 25/
	Pickings	5/ a 15/
TURMERIC, Bengal cwt.	Fair	25/
Madras ,,	Finger fair to fine bold	37/6 a 40/
Do. ,,	Bulbs ,, ,, [bright	23/
Cochin ,,	Finger fair	30/ a 32/6
	Bulbs ,,	20/
VANILLOES— lb.		
Mauritius ... 1sts.	Gd. crystallized 3½a 8½ in.	7/ a 12/
Madagascar ... 2nds.	Foxy & reddish 3½a ,,	6/6 a 7/6
Seychelles ... 3rds.	Lean and inferior	5/6 a 6/
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares, cwt.	Good white hard	59/

HIS EXCELLENCY SIR JOHN ANDERSON, G.C.M.G., K.C.B.,
Governor of Ceylon and President Ceylon Agricultural Society.

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SOME RUBBER ESTATE MIXTURES.

Many of the rubber estates in Ceylon have special mixtures of artificial manures, the composition of which is not as a rule made public. They may be applied yearly or in alternate years with or without an alternate mixture. As their composition is generally the outcome of experience on the part of the Visiting Agent or Superintendent or of advice obtained from a manure firm it may be worth while studying their composition to ascertain whether some underlying principles can be detected running through them. We have been examining eight such mixtures from the Central, Southern, and Western Provinces and tabulate their contents below. For obvious reasons we substitute numbers for the names of the estates or groups. The quantities are lbs. per acre.

	1	2	3	4	5	6	7	8
Ground Nut Cake	300	100		600		400	300	
Castor Cake ...					400			
Blood Meal ...	80	40				100	50	
Fish Guano ...						200		
Crushed fish ...	220	150						
Peruvian guano ...								200
Sulphate of Ammonia ...	60	40	300			75		
Nitrolim ...							100	
Superphosphate of Lime ...	60						50	
Concentrated superphosphate		25	75					
Basic slag ...				100	200			
Steamed bones ...						100		
Sulphate of Potash	80	25	180	100	150	125	100	
Analysis.								
Nitrogen ...	52·9	26·75	60	42	20	73	45·25	10
Phosphoric acid...	19·6	16·50	31·5	20	40	38	9	20
Potash ...	40	12·5	90	50	75	62·5	50	4

From the last three lines in the table, under analysis, it will be seen that the mixtures differ considerably from one another in composition. Taking phosphoric acid in each case as 100, we have the following ratios:

	1	2	3	4	5	6	7	8	Mean
Nitrogen ...	269	162	190	210	50	192	502	50	203
Phosphoric acid ...	100	100	100	100	100	100	100	100	100
Potash ...	204	75	285	250	187	164	550	20	216

We are as yet without data to enable us to determine which of the ingredients if any should be considered the dominant manure for Hevea rubber, or in what proportions generally speaking the ingredients should be mixed, though experiments to determine these points have been in progress for two years at Peradeniya, and some definite results should soon be available. We must, therefore, seek some other standard with which to judge of the various proportions that are in these cases employed. For this purpose we may take fresh cow dung, one of nature's manures, which has about 0·34 per cent. of nitrogen, 0·16 per cent. of phosphoric acid and 0·40 of potash. Calculated for 100 parts of phosphoric acid we have the following proportions:—

Nitrogen	...	...	... 212
Phosphoric acid	...	...	... 100
Potash	...	...	... 250

Referred to this standard the proportion of phosphoric acid in No. 1 and notably in No. 7 is low; Nos. 2, 3, 5, 6 and 8 have a deficiency of nitrogen, and Nos. 1, 2, 5, 6 and 8 a deficiency of potash. No. 4 conforms most nearly to the natural manure.

We have not before us any soil analyses of these estates; and if we had we should probably find that the soil on each estate showed considerable variation; but the composition of the soil should always, of course, be studied when mixtures are made up. It will serve our purpose to examine the analyses of a list of twenty-five Ceylon estate soils reported on some years ago by MR. KELWAY BAMBER, the Government Chemist, and published in RUTHERFORD'S Note Book. Following are details of the average percentage of some of the ingredients of these soils, the

highest and the lowest that are found in any of them, and the composition of a typical loamy soil in England:

—	Organic matter and combined water %	Nitrogen %	Phosphoric acid %	Potash %	Lime %
Average	10·433	0·165	0·070	0·142	0·185
Highest	15·910	0·331	0·169	0·328	0·608
Lowest	5·860	0·079	0·024	0·039	0·008
Typical Loam	5·660	0·170	0·380	0·80	1·280

With regard to nitrogen the average percentage in these soils compares favourably with that of a typical fertile, loamy soil in England, but the proportion of phosphoric acid, potash and lime is low; especially of phosphoric acid, which is about twenty per cent. of that of the loam. Even the soil richest in phosphoric acid is still deficient judged by this standard. In the light of these figures we should have expected to find phosphoric acid filling a larger place in Ceylon mixtures than it appears to do. The soils show up better in potash but are yet not rich in these constituents.

A feature of these Ceylon soils is their richness in organic matter and combined water and poverty in lime. These may be taken together because lime reacts on the acidity caused by organic matter and tends to release the locked up plant food. The average percentage of lime is only 14·4 per cent. of that of the loam; the Ceylon soils possess on an average an excess of organic matter. This being the case, the application of lime should find an important place in any general scheme of manuring rubber in Ceylon. R. N. L.

GREEN MAIZE FOR MILKING.

Green maize, if fed to milking cows before it shows the tassel, will do no injury, but it must be remembered that the greatest amount of nutriment is contained in maize when the cob is turning from the milky into the glazing stage. This, however, does not apply to any of the Sorghum family, such as Sorghum Saccharatum, Planter's Friend, and Amber Cane. These must on no account be fed to cattle unless in the flowering stage, or unless they have been allowed to wilt; that is to say, Amber cane cut in the morning can be fed in the evening or if cut in the evening can be fed the following morning without any danger to the stock.—THE AGRICULTURAL NEWS (DURBAN).

COCONUTS.

THE GERMINATION OF THE COCONUT.

In the JOURNAL OF HEREDITY for April last is to be found the result of a most interesting study of this phenomenon by MESSRS. COOK and DOYLE of the U. S. A. Department of Agriculture.

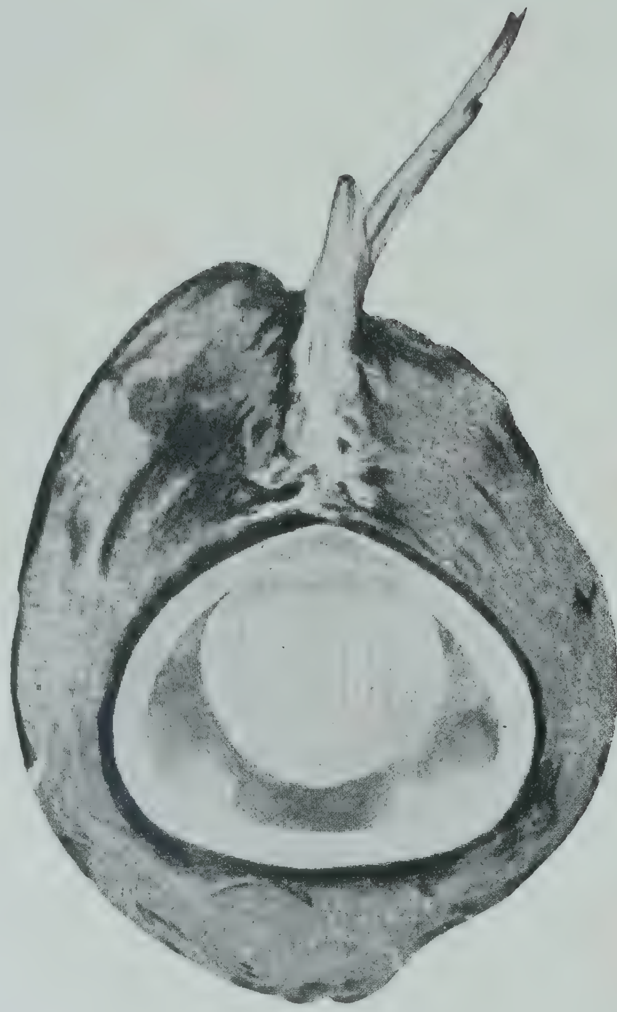
The article opens with the laconic remark that "Coconuts are seeds," but as the term coconut is applied in the article itself to the nut with the husk on, the statement is somewhat misleading. In reality the coconut is a drupe or stone-fruit, in which the stone is enveloped in a fibrous mesocarp. The true seed lies within the hard woody endocarp or shell of the so-called "nut," which by the way is again a misnomer.

The authors dispute the theory of maritime distribution, maintaining that the coconut is neither a sea-shore plant by nature nor dispersed by the sea. In support of their contention they state that the same type of husk which characterises the coconut and leads people to believe that it is intended to float in water, is found in many other species of palms which do not grow on the sea coast and are known never to be distributed by water: while the waxy coating on the husk (believed to be a water-proof material) is common to all palms and found specially well-developed in many inland species.

In spite of the coconut being so abundant and of such economic importance in the Pacific Islands, there is according to the authors nothing to show that its habits enable it to exist permanently or in a truly wild state in a littoral or oceanic environment. The common belief of its being a native of this region is stated to be contrary to the opinions of those who have studied the palm as it grows in the Pacific Islands. These authorities are of the view that there are no wild coconut palms in the Pacific, that it has everywhere been actually planted by man, and that the palm does not survive human neglect for any period.

It is argued from the store of water in the interior, the large supply of solid endosperm and the thick fibrous husk, that the native habitat of the coconut must have been a relatively dry clime where the plant had to grow to a fairly large size before it could draw upon soil moisture: while on the other hand such provision would seem unnecessary in a maritime plant. The great size of the nut would indeed be a disadvantage in this latter situation as preventing it from being buried in the sand. The palms that are known to live on the shore have small seeds. We must, therefore, according to the authors, think of the coconut as an interior palm growing in an alkaline soil and subject to prolonged droughts, in order to appreciate the significance of its large seed, its copious supply of endosperm and water and thick spongy husk capable of absorbing moisture when brought within reach of it. As is generally known the coconut is also intolerant of shade, and this points to its original habitat being a region where other vegetation was absent or very sparse.

Going back to the husk, one cannot fail to notice its suitability as a medium for starting the growth of roots. Indeed the coconut may be likened



A

B

C

THE GERMINATION OF THE COCONUT.

A. Longitudinal section of germinating nut showing Cotyledon or "nursing foot." (Reduced).

B. Coconut seedling removed from shell showing narrow "neck" between the cotyledon and the sprout through which the nourishment is carried. (Natural size).

C. Dried coconut sprout, with the cotyledon removed, showing the fibres that arise in the cotyledon and pass through the neck into the base of the young plant. These fibres probably serve to convey nourishment to the sprout. (Enlarged about $2\frac{1}{2}$ diameters).

to "a self-potted plant," and the hanging up of coconuts till the whole process of germination is complete, and the green plant has appeared is a fairly common practice which supports this view.

A remarkable thing about the coconut is the small size of the embryo or living germ in comparison to its other parts. It is a tiny cylindrical body lying just beneath the largest eye in the shell. When germination begins the embryo elongates and enlarges at both ends. From the outer end arise the young stem and roots, while internally is formed a large spongy mass called the cotyledon through which are scattered vascular stands which converge and become fibrous at the narrow neck connecting the spongy mass with the stem.

The function of the cotyledon is to convey the food material derived from the solid endosperm to the seedling plant. In order to be absorbed this material has to be digested under the influence of the ferments secreted by the cotyledon and passed into the water contained in the central cavity.

The fluid-filled cavity would in addition to its storage function appear to play the part of a stomach to provide for the digestion and absorption of food material stored in the solid endosperm. In this way the milk would be periodically recharged with food materials to replace those absorbed by the cotyledon.

It is unnecessary to follow the various changes in composition of meat and water which take place as the process of germination goes on.

We would direct attention to the illustrations accompanying this summary of a most interesting paper. They are selected from a number of excellent photo. reproductions which appeared with the original article in the JOURNAL OF HEREDITY, to which periodical we duly acknowledge our indebtedness.

C. D.

LOCUSTS.

Noakhali Plantation,
Akyab (Burma),
The 15th April, 1916.

To the EDITOR of the TROPICAL AGRICULTURIST,
Peradeniya, Ceylon.

SIR,—Will you, or any Ceylon coconut planter be good enough to let me know through your valuable journal the most effective method of diminishing the pest of locusts which do considerable damage to the trees here? They breed near small shrubs during February and March, and by the time the rains begin in May they are full grown. They attack chiefly the younger trees from two to five years, and they are always found in such large numbers on the trees, that the trees appear a black mass. They do not take long in their work as they ruin a tree in a few hours. We have used Lead Arsenate on the trees to prevent their attack, but this did not prove beneficial as the rains washed the solution off.

I shall be glad to know of any means of exterminating this pest if possible.

(2). The coconut beetle found here is the *Oryctes Rhinoceros* which do the most damage. They attack young and old trees alike and are most abundant during the hot season. We employ men to search for the beetles on the trees and at the same time clear the trees of all dead leaves and rubbish

and apply a solution of tar to the parts attacked. We have found this most effective, and the clearing of the trees too have helped them a good deal. The trees are now looking quite fresh, and the crops have almost doubled. I shall be glad to know of any cheaper and better method.

I have the honour to be, Sir,

Your most obedient servant,

PERCY A. HERFT.

As the question of locusts is being brought up in Ceylon the following note by the Assistant Government Entomologist will prove of interest and may be inserted here :—

The species of locust is not mentioned and specimens are desirable for identification. In Ceylon, the only locust that has proved a serious pest is the painted (or spotted) locust, *Aularches miliaris*, L, which occasionally appears in considerable numbers in places and does a good deal of damage to coconut and areca palms, dadaps, breadfruit trees and other plants. This insect is, however, of a sluggish nature and does not form masses and migrate from place to place, leaving a track of desolation behind it, as do the true migratory locusts of parts of Africa, India, etc. Nevertheless, it must be regarded as potentially a dangerous insect and no outbreak of it, however slight, should be neglected. It commonly occurs amongst the pernicious "illuk" grass.

In addition to the spotted locust, which is a very gaudily coloured creature, we have several species which are more closely allied to the ones which cause such havoc in the countries mentioned above. So far, these have not made themselves troublesomely conspicuous in Ceylon and they are not likely to become serious pests here at present owing to the nature of the cultivated parts of the country. Hilly and well-wooded country does not lend itself to locust invasions, but when the flat low-country is brought under cultivation it is not unlikely that Ceylon may have its share of locust-plagues. It is well, therefore, to be watchful.

The two most vulnerable points in the life-history of all locusts are (1) the egg-stage, (2) the nymphal, or "hopper" stage when the insects are unable to fly and can only hop along the ground. In the first stage, the eggs, which are laid in masses just below the surface of the soil, can be turned up by ploughing or hoeing and destroyed. In most countries which are afflicted with locust-plagues, however, it is found that the easiest and most effective way of dealing with them is to attack them while the insects are still in the young "hopper" stage. During this period, which lasts for some time, the young locusts are rounded up and either herded into deep ditches which have previously been prepared for them, or caught by ingenious nets which are dragged over the infested fields and scoop up all locusts in their path. Such methods as these only lend themselves to fairly flat country and are largely dependent for their success on the nature of the cultivated crops in the affected district.

In dealing with all locust plagues, it is necessary to watch the outbreak from the very first so as to discover the time when the insects can be most easily dealt with. In most cases, as mentioned above, this will be while they are in the "hopper" stage. Circumstances, however, vary so widely that no single method can be regularly adopted and each outbreak must be combated by such means as prove to be most effective and feasible in each case.

G. M. HENRY.

CACAO.

SALE OF COCOA.

The following prices have been obtained for cocoa in Colombo on 27th April:—

No. 1 good bright colour sun-dried	...	Rs. 52/– per cwt.
No. 2 clayed black cocoa ...	...	,, 42/– ,, ,,
No. 3 Nicaragua cocoa ...	...	,, 45/– ,, ,,
No. 4 good dull room-dried cocoa	...	,, 43/– ,, ,,
No. 5 black inferior cocoa ...	...	,, 16/– ,, ,,

It will be seen there is a difference of Rs. 9/– per cwt. between equally good cocoa but of bright and dull exterior skins which of course in no way affects the quality or flavour of the bean.

Under ordinary circumstances the difference between good cocoa and black, i.e., that obtained from unripe or fungus pods is about Rs. 20. In this case the black cocoa was roughly picked over and the unbroken beans coloured with Indian clay. These fetched Rs. 42/– per cwt. or only Rs. 10/- less than the best quality. As it costs only 60 cents per cwt. to clay the beans there is a clear profit of Rs. 9/50 per cwt. over unclayed black.

No. 5 inferior cocoa was the remainder of the broken black cocoa.

The Nicaragua cocoa fetched Rs. 8/– less than good mixed Forastero cocoa owing to its dull colour, though the beans are twice the size.

D. S. CORLETT,
Manager, Expt. Stn., Peradeniya.

MANURIAL EXPERIMENTS ON CACAO IN TRINIDAD.

J. VERTEUIL.

This report deals with the further results of the cacao experiments including manurial, shade, chupon (suckers) and natural yield plots. The manures were applied broadcast to an area within 3 feet of the trunk of each tree and the soil forked to a depth of about 6 inches. The climatic conditions were very favourable, the increase in crop over that of the previous year being in several cases as great in the no-manure (or control) plots as in those under manurial treatment.

All manures except lime alone gave an increase on the previous yields, the increases being greatest with mulch and sheep manures, either alone or in combination with artificial manures. The greatest increase (72%) was obtained with mulch in combination with basic slag and sulphate of potash, followed by a plot with a similar mixture containing pen manure in place of mulch, but owing to the high cost of the mulch the most profitable crop

($ 166 per acre) was obtained with a combination of pen manure, sulphate of ammonia and sulphate of potash. The next most profitable mixture was sulphate of ammonia and sulphate of potash, with a profit of $ 148 per acre.

The shade experiments have not yet reached a conclusive stage. Removal of shade trees in 1910 resulted in a considerable decrease in yield during 1911–13; a considerable improvement occurred in 1913–14, but the yield is still below that of the year preceding the removal of the shade.

Experiments to compare the effects of partial and complete removal of chupons appear to favour their complete removal in the case of young trees up to 10 years, but the results with older trees of 25 to 30 years do not show any definite advantage from any treatment regarding chupons.

The natural yield plots with trees 32 years old do not show any uniform variation in yield due to season and increasing age. These results give further support to the statement made in previous reports, viz., that to be able to arrive at reliable conclusions as to the relative value of different manures applied to cacao trees, it is necessary to ascertain the natural yield of the plots over a series of years previous to the application of the manures.

The general conclusions drawn from these experiments are as follows:—

(1) Although a favourable season considerably reduces the percentage of trees bearing less than a pound of dry cacao per annum, the proportion of these during the two years for the above fields is not less than 30 per cent. on an average.

(2) The comparative yield of the plots on each field for each year is largely dependent on the relative proportions of high and low bearing trees, and generally the percentage of trees bearing less than 13 pods per tree appears to exert the largest influence on the relative yield of the plots.

(3) Generally the heavy bearing trees of the first year have continued to be heavy bearers, and the poor yielding trees have remained poor during the following year; the detection of poor bearing trees on an estate and their subsequent replacement with trees raised from stock or budded trees of known prolific and other qualities is deserving of serious consideration. The advisability of improving the crop of poor yielding fields on an estate by replacing the trees which bear an average of less than 13 pods annually is clearly indicated and should form part of future experiments on the natural yield plots.—BULL. INT. INST. OF AGRIC.

To the EDITOR, TROPICAL AGRICULTURIST.

DEAR SIR,

MR. J. P. LEWIS will be glad to hear that the cultivation of the lima bean in which he is interested has been taken up extensively in the Kandyan country and that the produce is seen in the market in large quantity.

The Agricultural Society is endeavouring to eliminate as far as possible the varieties with coloured seeds as being less wholesome, and has recently imported and distributed white seed varieties.

The Soya bean is, however, not being taken up in the same way.

Yours faithfully,
C. D.

TOBACCO.

ANNUAL REPORT OF THE GOVERNMENT TOBACCO PLANTER FOR 1915.

In addition to the immediate supervision of the work at the Tobacco Trial Grounds, Jaffna, during the past year, the Tobacco Planter has visited Batticaloa, Trincomalee, Teldeniya, Rangala, Peradeniya, Galle, Anuradhapura, and practically all localities of the Jaffna Peninsula, including some of the adjacent islands. The total number of miles travelled during the year was approximately 4,500. Tobacco talks were made at most of the abovementioned places, lands inspected, and advice given regarding the suitability of the soil for tobacco growing, and at many places growers were induced to put in trial plots, employing improved methods. Seeds have been furnished to them with written instructions regarding the cultivation, etc. A number of papers, treating of preparation of tobacco nurseries, selection and preparation of tobacco lands, and methods of cultivation, have been written for the Jaffna Local Tobacco Committee.

The total number of inward and outward letters for the year was 525.

Twelve samples of tobacco have been received for opinion, and samples from the Jaffna trial ground have been despatched to the Imperial Institute, London, for report.

A record was kept for the months of May and June during the curing, stripping and grading season, and the number of visitors was 1,800.

GENERAL METHODS EMPLOYED IN CULTIVATION.

The work as outlined in last year's report was carried through. The following methods of watering the plants were employed; the young plants were watered once every four or five days and mulched. When the watering by channels was begun, the crop was watered but once a week. As we had only one well sweep for watering four or more acres of tobacco—and a sweep is only supposed to have a capacity for watering one acre—the water was necessarily continued far up into the heat of the day, which, of course, was not the best for the crop. It was only by frequent shallow cultivation, and our system of mulching the channels, that we were able to retain anything like sufficient moisture.

The chewing types were topped and suckered in the usual manner and produced a fairly fleshy leaf of good flavour. The flowering heads were not removed from the cigar types, until just prior to harvesting, the object being to prevent the leaf from becoming too thick and fleshy for cigar purposes. Though a delay in the completion of our curing barn prevented the harvesting of our cigar types at just the proper time, the quality is quite satisfactory and the yield fair.

INSECT PESTS.

The worst insect with which we in the Jaffna Peninsula have to contend is the small black flea grasshopper, which come in large numbers to attack the seedlings in the nursery when they first appear. They bite off the tops

of the minute seedlings, and, owing to the small amount of plant food stored in the seed and the undeveloped state of the roots, at this stage, they are incapable of further growth.

Some of the most delicate types of cigar tobacco are attacked in later stages, after transplanting to the field, by the "green fly;" the larvæ of which attack the plant in great numbers. They suck the juice from the leaves, leaving them papery and lifeless.

HARVESTING.

The harvesting was done in March and April. All types except cigar wrapper were harvested by the method of splitting the stalk to within a few inches of the ground, cutting it off and placing it across a tobacco lath. Six plants were placed on each lath and the laths were hung on poles in the curing shed.

The cigar wrapper leaf was harvested by the pruning or single leaf method, as it is most important to take the leaves just at the proper stage of ripeness, and all the leaves of a plant do not ripen at once.

CURING.

Most of the crop was cured by what is known as the air curing method, with excellent results. One small amount of chewing tobacco was cured by the process known as open fire curing, and the result was good. A small quantity of the chewing type was partially cured by the flue method, but owing to the moisture in the newly-constructed walls of the flue house, built of lime, mortar and stone, we were unable to procure a sufficiently high temperature in the initial stages of the curing; so the tobacco was removed from the flue house and the curing finished in the air curing shed.

FERMENTING.

The crop was stripped and graded and the cigar tobaccos bulked for fermenting on the 8th June. As we had no regular fermenting house, the work was done in an ordinary room. The heat produced by the fermentation dried the bulk and it was rebuilt from time to time, each layer of the tobacco being lightly sprinkled with water. The process of fermentation is about completed.

FERTILIZER EXPERIMENTS.

These tests show that a manure composed mainly of nitrogen and potash is best suited for this locality. Buried tulip leaves gave the heaviest yield but not the best quality. It is interesting to note that a half portion of commercial manure and a half portion of cattle manure gave exactly the same yield as a full portion of cattle manure, the quality, in the first instance, being better. These experiments are to be duplicated in 1916.

VARIETY TESTS.

Forty-two varieties of tobacco were tried, from which twelve selected varieties were grown in the test plots. The variety tests were valuable in ascertaining what types were best suited for the Jaffna District as regards quality, and selected types from the varieties grown will be planted for the 1916 crop.

GREEN MANURE CROP.

In November the entire garden was sown to Sunn Hemp, and in December we began ploughing it under on all land intended for cultivation during the next season. The hemp, having made a good growth, provided an excellent green manure.

NURSERIES.

Our nurseries for the next crop at the Jaffna trial grounds were sown the first day of November and transplanting was begun on December 30th. On November 11th a nursery was sown at the Dry Zone Experiment Station, Anuradhapura, to provide plants for the trial plots to be located there.

PUMPING PLANT.

A pumping plant has recently been installed and will afford excellent facilities for watering the garden in the future.

BUILDINGS.

A small fire curing house and a large barn for air curing were erected.

ADVERTISING THE WORK LOCALLY.

In June, a committee known as the Jaffna Local Tobacco Committee was organised and was composed of the Government Agent, Northern Province, the Tobacco Planter, and ten leading Tamil gentlemen selected by MR. HORSBURGH. The object of the organization is to take measures to bring the work done by the Tobacco Planter and the results obtained, as well as the improved methods of cultivation and curing, to the notice of the tobacco growers, and to induce them to adopt these methods. Monthly meetings have been held, at which papers were read and approved for publication in Tamil, and distribution. Thanks are due to MR. HORSBURGH and the Committee for their interest and their efforts in the furtherance of the work.

B. F. SCHERFFIUS,
Tobacco Planter.

STIMULATING THE MILK FLOW.

The dairy cow can often be brought up to a high degree of efficiency by some very simple means. The persistency of the milker will pay well for all the extra time spent. Try to make the cow think she has not given enough and she will set about to make it up next time. A little milk left in the udder will make her think she is giving more than she is expected to, and at the next milking she will not have quite so much for you.

There is a great difference in the per cent. of butter-fat in the first and the last milk drawn. The first will sometimes be as low as 1 per cent. and the last has been known to run as high as 12 per cent. It pays to work for the strippings. The manipulation of the udder will often result in the increase of a pound of milk. This is usually done after the milker has secured all the milk he can by taking the teat in the hand and pushing the udder up close against the body, repeating this about three times with each quarter, in turn, between the hands with the hands close to the body and rub down. The extra milk secured at a single milking may not pay for the time, but it will stimulate the cow to give that much more at the next milking with extra work. Here is where the profit will come in.

We all know that a cow with which the calf is allowed to run will very soon adjust the flow of milk to the needs of the calf, and it is equally true that the dairy cow can and will increase the milk flow if encouraged by the milker. Get all the strippings. It will pay.—THE AGRICULTURAL NEWS (DURBAN).

CASSAVA.

CASSAVA: ITS CULTIVATION AND UTILISATION.

(*Continued from p. 316.*)

HARVESTING AND YIELDS.

The time of harvesting depends on the habit of the variety, on the climatic conditions, and on the use to which the roots are to be put. If required for the preparation of starch or tapioca the roots must be harvested when they contain the maximum amount of starch. Some varieties mature in as little as seven or nine months, others take twelve or fifteen months or even longer to attain their full growth, and consequently no hard and fast rule can be laid down. It has been shown, however, that no advantage is derived by allowing the roots to remain in the ground after they have become mature; they may continue to increase in size, but they become more fibrous and woody and so are less suitable for the manufacture of starch. As the roots do not keep well after being removed from the soil, except with very careful treatment, they are only dug as required when used for food. If frosts are likely to occur, an early maturing variety must be chosen, so that the roots can be dug before the cold weather sets in.

Owing to the size of the roots they have to be removed by hand. In very light soils this can be done without the use of tools by simply grasping the base of the stem with the hands and pulling the roots. Much labour and time can be saved, however, by the use of some simple tool, which is always necessary on heavier soils. Sometimes an ordinary grubbing hoe is used, but perhaps the most convenient tool consists of a V-shaped hook 5 or 6 inches in length, one arm of which is fixed to a wooden pole, 8 feet in length and 2 inches in diameter, at a distance of about 2 feet from the end. To lift the roots the hook is placed under the point of attachment of the roots to the stem and the whole cluster then levered up. To prevent the end of the lifter sinking in the soil, a flat piece of iron or an old spade is sometimes fixed to the short end, and this is also useful for any actual digging which may be necessary. The work is much facilitated if one or two men precede the diggers and cut down the stems to within 6 inches of the soil.

The yield of roots varies considerably in different countries, and depends not only on the variety grown but also on the character of the soil, the amount of cultivation which has been given, and the vigour of the original cuttings. On poor soils the yield may not exceed 2 or 2½ tons of fresh roots per acre, but on a particularly good soil as much as 15 tons per acre has been obtained in the United States. Much higher yields than this have been reported, but as a rule these are estimates obtained from the weight of a few roots and cannot be accepted as representative of actual practice. On the whole, 8 tons of fresh roots may be considered a good average yield.

No attempt will be made to recommend any particular varieties for cultivation, as the yield of one and the same variety varies in different localities and on different soils, and it is necessary to carry out careful tests of a

series of varieties before the best for any given place and purpose can be correctly ascertained. As a rule the bitter varieties give a higher yield of roots than the sweet varieties, and are therefore preferred for the production of starch, but under the conditions obtaining in the United States sweet cassava has given the best results for this purpose. Not only does the yield of tubers vary in the different varieties, but also the starch content and the time of maturity, as is shown in the following table, which gives the results obtained in a series of experiments carried out a few years ago at the Hope Experiment Station, Jamaica:—

Variety.	Yield of roots (tons per acre).			Quantity of starch in the roots (lb. per acre).		
	At 12 months	At 15 months	At 21 months	At 12 months	At 15 months	At 21 months
Blue Top ...	8·25	14·2	21·9	5,636	9,733	15,818
Black Stick ...	6·5	6·5	18·0	4,878	5,197	15,433
Smalling ...	7·5	11·1	19·3	5,494	8,553	13,883
Mullings ...	5·75	11·1	18·0	4,160	8,180	13,277
Long Leaf Blue Bud	9·0	15·4	15·4	6,552	12,857	13,187
White Top ...	10·5	11·0	11·6	7,902	7,638	8,753
Luana Sweet ...	6·75	8·1	9·0	5,322	6,540	7,102
Rodney ...	7·5	9·7	10·3	5,337	6,931	6,547

HYDROCYANIC ACID IN CASSAVA.

The presence of hydrocyanic acid (prussic acid) in cassava roots was first recorded by BOURBON-CHARLARD in 1836. As a result of investigations conducted at the Imperial Institute it was ascertained that the acid does not wholly occur as such in the root, but is generated by the action of an enzyme on a glucoside. The latter was subsequently ascertained to be phaseolunatin, which also occurs in certain varieties of *Phaseolus Lunatus* beans (DUNSTAN, HENRY & AULD, Proc. Roy. Soc., 1906, B, 78, 152). Owing to the great importance of the subject most of the investigations on the occurrence of hydrocyanic acid in cassava have been concerned with determining the amount yielded by sweet and bitter varieties respectively. FRANCIS in 1870 was the first to show that hydrocyanic acid is yielded by sweet cassava roots. He found that the average amount furnished by the whole root was 0·0168 per cent., the highest being 0·0238 and the lowest 0·0113 per cent. CARMODY, in a paper published in the LANCET in 1900, showed that although sweet cassava may yield as much hydrocyanic acid as the bitter form, there is a difference in the distribution of the acid in the roots in the two cases. In the sweet variety he found that most of the hydrocyanic acid was in the skin and outer cortical layer, whilst in bitter cassava it was more evenly distributed through the root. As it is the almost universal practice to peel the sweet cassava roots before eating them, the fact just mentioned explains why cases of poisoning by this variety are so rare. Typical examples of CARMODY'S

results are shown below :—

Sweet Cassava.		Bitter Cassava.	
Inner part.	Skin and outer cortical layer.	Inner part.	Skin and outer cortical layer.
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
0·006	0·033	0·031	0·024
0·003	0·014	0·021	0·025
0·015	0·033	0·014	0·013
0·008	0·031	0·017	0·019
0·011	0·020	0·016	0·024
0·004	0·024	0·013	0·016
0·010	0·030	0·032	0·035

These results have been confirmed in the main by subsequent observers. COUSINS, for example (BULL. AGRIC. DEPT., JAMAICA, 1907, 5, 78), found that twenty-four out of twenty-six Columbian varieties of sweet cassava grown in Jamaica had most of the hydrocyanic acid in the cortical part of the root. The remaining two, although sweet to the taste and found by actual experiment on four persons to be non-poisonous, contained 0·0062 and 0·0024 per cent. of hydrocyanic acid in the cortex and 0·0114 and 0·0130 per cent. in the interior, respectively.

MOORE (BULLETIN No. 106, 1906, BUR. CHEM., U. S. DEPT. AGRIC.), however, found that in specimens of both bitter and sweet cassava grown in Florida, most of the hydrocyanic acid was in the skin and cortex. His results were as follows :—

	Sweet cassava (Florida Sweet.)		Bitter cassava (White Top).	
	Proportion of part to whole root.	Hydrocyanic acid.	Proportion of part to whole root.	Hydrocyanic acid.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Skin ...	1	0·068	1	0·076
Cortex ...	25	0·054	12·5	0·023
Inner part ...	74	0·002	86·5	0·0005

MOORE states that the proportion of hydrocyanic acid present varies not only with the variety but also with the size of the root. The smaller roots, containing a relatively larger proportion of skin and cortex, yield more acid than larger ones, whilst the lower part of a tapering root of a bitter variety (White Top) contained 0·039 per cent. of hydrocyanic acid, the large upper

part containing 0·028 per cent., whilst a small root of a sweet variety (Florida Sweet) contained 0·005 per cent., the average-sized root of that variety containing only 0·002 per cent.

COLLENS (BULLETIN, DEPT. AGRIC. TRINIDAD AND TOBAGO, 1915,14,54) obtained somewhat similar results in the case of bitter cassava, but in roots of sweet cassava he found that the lower part yielded less acid than the upper. So far the reason for this difference has not been ascertained.

The amount of hydrocyanic acid in cassava may also be increased or diminished when a variety is grown in a new locality. COUSINS (BULLETIN AGRIC. DEPT., JAMAICA, 1907,5,78.) found that a number of Colombian varieties of sweet cassava when grown for one year in Jamaica yielded on the average 0·0034 per cent. of acid, but after having been grown for five years the yield was 0·0124 per cent.; the increase in this case was mainly in the cortex, which yielded an average of 0·0649 per cent. of acid. The results obtained by MOORE in Florida, on the other hand, seemed to indicate that the yield of acid decreased after continued cultivation.

The fact that the yield of acid varies when one and the same variety is grown in different localities, was also demonstrated by MOORE, who obtained the following results among others:

Variety.	Miami, Florida. *Per cent.*	Biloxi, Missouri. *Per cent.*	Cuba. *Per cent.*
1. Helada	0·010	0·003	0·015
2. ,,	0·001	0·001	0·016
3. Negrita	0·005	0·007	0·007
4. ,,	0·002	0·003	0·022
5. Pie de Perdiz	0·009	0·001	0·008
6. Mantera	0·008	0·002	0·040

Hydrocyanic acid is yielded by all parts of the cassava plant, as is shown by the following results given by COLLENS in the paper referred to:

	Sweet *Per cent.*	Bitter. *Per cent.*
Top: Full-grown green leaves	0·0162	0·041
Green stem where leaves arise ...	0·0144	0·024
Woody mature stem: Green cortex or peel ...	0·043	0·113
Inner woody portion	0·0072	0·0027
Pith	0·019	0·076
Roots, freshly dug: Peel	0·0147	0·055
Inner part	0·0048	0·053

—IMP. INST. BULL.

According to the WEST INDIA COMMITTEE CIRCULAR a cacao tree on an estate in the Tamana Ward in Trinidad has set botanists talking by producing two distinct kinds of cacao pod on the same branch, a red pod of the *forastero* variety and a yellow one of the *calabacillo*. At a recent picking the tree yielded eleven yellow pods and seven red ones.

SOILS AND MANURES.

THE RESPECTIVE VALUES OF ORGANIC AND INORGANIC MANURES.

H. E. P. HODSOLL.

(Continued from p. 325.)

Biological.—Lastly, let us consider the effect of these two classes of manure on the bacterial life of the soil. This is, perhaps, the most important aspect of all. For some time it had been difficult fully to explain the effect of organic manures on the growth of the crop, and to account for this fact that plants so fed seemed to have more "life" in them. One could only say that decayed animal and vegetable matter was the natural plant food, and that there was probably some affinity in the life of the organic materials—as evinced by the growth of fungi, etc., that they support (by some erroneously considered a disadvantage)—and the life of the plant; though, needless to say, this was scoffed at by the holders of the mineral theory.

Recent work on bacteriology undertaken and ably carried out, among others, by RUSSELL and HUTCHINSON of Rothamsted, has thrown much light on the subject. They have shown that bacteria are absolutely dependent upon humus in the soil, that they feed on it, use it as their fuel, and get their energy and power from its combustion, and it is thus absolutely essential for their life.

We now know that the soil is not an inert mass acting merely as a medium to hold plant foods, and an anchorage for their roots, but that it is indeed a life, that it is in fact a huge factory peopled by millions of minute organisms that are there to prepare the food already in the soil and supplied as manure for the delicate root hairs of the plant.

It has been shown that these workers are wonderfully organised; that there is a perfect division of labour among them, each group having its appointed task; when each particular group has done its part, it, so to speak, hands it on to another for the next operation, and so on until the insoluble material on which they are working has been completely broken down into a form readily assimilable by the plant.

When we realize that such substances as farmyard manure would not only be useless but actually harmful to the plant were it not for the action of these beneficial bacteria, we begin to see the importance of the part they play in plant nutrition and in the great scheme of life.

It is impossible in the short time we have at our disposal to go into this fascinating study, but as an instance of how these minute organisms work it is interesting to note that every organic manure that is applied to the soil has to be attacked by at least three separate groups of bacteria before the plant can get at the ammonia it contains, the nitrogen being first turned to ammonia, then to nitrite and then to nitrate, which is soluble and can be taken up by the plant.

Another bacterium has the power of fixing the free nitrogen of the air and bringing it into use for the plants.

Bacteria also play an important part in bringing phosphates and potash into solution. It has been proved that mineral phosphates only work well on a soil containing plenty of organic matter; this is because the carbonic acid gas generated by the bacteria enters into the water and dissolves the phosphates, otherwise they are very ineffective.

It is clear, therefore, that we are absolutely dependent on the bacteria in the soil, and especially is this the case with the intensive cultivator who uses the soil as a manufacturing medium to convert the fertilizers he applies into crops.

As I have said, bacteria feed on humus and must have it, and we therefore see how necessary it is to use organic manures that supply this all-important ingredient.

On the other hand, the mineral manures, as we have seen, not only contain no humus, but by the acid residues they leave in the soil (especially superphosphate and sulphate of ammonia) and by the bad effect they have on its physical condition, they are actually harmful to bacterial life.

So that from this aspect also we see that the organic manures are far preferable to those obtained from mineral sources.

In spite of these great advantages, however, I do not deny that the minerals have their uses. For rapid results, in cases where we want to stimulate the plant into very quick growth, we must use the mineral forms of nitrogen—such as nitrate of soda, nitrate of lime, sulphate of ammonia, etc.—because they require to undergo practically no change before being taken up by the plant. They produce an unnaturally quick, soft, and sappy growth, just the thing we want to avoid in permanent crops like fruit, but, on the other hand, just the thing we require in green crops like cabbage, lettuce, etc., because besides giving us earliness they also produce a tender leaf, though, if this is over-done, the produce is apt to be unwholesome as food.

There is probably also another reason why minerals are of considerable value, and this is the subject of very interesting investigation by the American agricultural chemists.

It is now generally admitted that all plants as a result of their growth give rise to a certain toxin or poison in the soil, the toxin being peculiar to the particular crop, and, as a rule, a poison only to that crop. In some kinds of plants this is much more noticeable than in others; probably two good instances are strawberry and clover, which, as we know are difficult to grow continuously on the same site. At the other extremity we have wheat and mangolds, which Rothamsted shows us can be grown for many years in succession on the same soil.

These toxins have probably a great deal to do with the advantages of rotation, as this system gives the soil time to rid itself of these substances, which we must remember are poisonous to the one crop only.

Intimately connected with this matter is the recent work of Russell and Hutchinson on soil sterilization. They found that after the soil had been sterilized plants grew very vigorously in it. The reason for this vigorous growth is probably that owing to intensive cultivation the bacterial flora had got out of balance, and that a certain comparatively big amœba that feeds on the beneficial bacteria had got the upper hand.

Owing to its larger size this amœba is more vulnerable, and suffers more than the beneficial bacteria from the sterilization; consequently, after that operation, the latter, being relieved to a large extent of the preying of the amœba, are able again to flourish, with the result that they carry on work more vigorously than ever, and large quantities of dormant food material are again prepared for the plant.

The reason why I have mentioned this is that the work of the Americans goes to show that the mineral manures act on the soil as a partial sterilization: that is, to bring about to a slight extent the state of things to which I have just referred; and for this reason they are beginning to regard them as useful, mainly for combating the soil toxins.

This is a most interesting theory, and if correct—as there seems every reason to believe—provides a further instance of the use of minerals.

The practical conclusion of the matter is therefore probably this:—

Use organic manures as a base to supply humus, and thus improve the texture of your soil and enable you to get a good tilth and a good seed bed, to give you gradual feeding of the crop, which promotes healthy growth and good quality, and to provide humus to feed bacteria.

Use mineral manures as a top dressing for rapid growth, and to act as a sterilizer to keep the bacterial flora in balance.—JOUR. OF THE ROYAL HORTICULTURAL SOCIETY.

EFFECT OF REMOVING SOLUBLE HUMUS FROM SOIL.

WILLIAM WEIR.

The only experiment on the part played by soluble humus in plant nutrition was recorded by GRANDEAU in 1872. Removal of the humus by means of hydrochloric acid and ammonia rendered the soil sterile to the growth of beans.

During the past two years this experiment has been repeated on a larger scale. The removal of the soluble humus was effected by washing the soil with dilute hydrochloric acid to remove bases and then repeatedly extracting with dilute soda. Some 40 per cent. of the nitrogen in the soils was removed in this way.

Two soils were used: a medium garden soil and a typical loam. Two pots of each soil were used: one treated and the other untreated. Chalk was added to the treated soil to replace the carbonates removed by the acid treatment and 1 gram KH_2PO_4 in solution was added to each plot. Wheat was sown in March, 1914, and cut in August. The soil was then taken out, mixed afresh and replaced ready for sowing with mustard. This crop, which scarcely grew beyond the seed-leaf stage, was removed on October 8th and weighed. The soils were then cultivated but not otherwise disturbed, and on October 13th all the plots were sown with rye and grown in the glasshouse until February 18th. Mustard was then sown as the fourth crop after removing and drying the soil.

The crop and nitrogen data for the different soils are summarised in the following table :—

Soil.	Wheat.		Mustard.		Rye.		Mustard.		Total weight.	
	wt. of crop.	wt. of N.	wt. of crop.	wt. of N.	wt. of crop.	wt. of N.	wt. of crop.	wt of N.	wt. of crop.	% of N.
Medium garden soil	67·8	·64	2·7	·06	3·1	·12	11·3	·24	84·9	1·07
,, ,, extracted	72·3	·73	3·9	·08	3·7	·14	10·8	·24	90·7	1·19
Typical loam	45·3	·37	13·1	·025	5·4	·20	15·4	·30	79·2	1·13
,, ,, extracted	67·2	·71	0·9	·03	6·6	·28	1·3	0·5	76·0	1·07

Thus, in five cases out of eight the plants obtained more nitrogen from the extracted than from the untreated soils; in one case the amount was the same and in two cases the amount was less, but on both these occasions the crop (mustard) failed on one soil.

During 1914-15 additional quantities of the same two soils were extracted and sown with wheat in precisely the same manner. In this case a smaller amount of humus (36 per cent.) was removed. In the case of the garden soil sown with wheat in November the untreated soil gave a better crop, whilst in the loam soil, which was not sown until March, the plants in the extracted were greener and weighed heavier than those in the untreated soil.

Determination of the nitrate and ammonia production and bacterial counts were made of the four soils. The formation of nitrate was less marked in the treated soils, in which ammonia tends to accumulate. The untreated soils appeared quite normal in this respect. The numbers of bacteria in the treated soil are initially very low, then become abnormally high and remain above the usual level; there is, however, no corresponding increase in the production of ammonia and nitrate. This result is similar to that obtained by Buddin on treating soils with non-volatile antiseptics.—Bull. Int. Inst. of Agric.

SOME SOIL PROBLEMS.

E. J. RUSSELL.

We have seen that most of the changes can be brought about by a number of organisms. Thus the fixation of nitrogen may be effected by the ærobic Azotobacter or the anærobic Clostridium. The production of ammonia can be brought about by moulds, by large bacilli, or by small micrococci, organisms differing considerably in their requirements. Thus the continuance of the decomposition is less dependent on the conditions than might *a priori* be expected, and if the reaction cannot be brought about by one set of organisms it can by another. Changes in conditions may alter the speed of the reaction or they may alter the agents bringing it about, but they have less effect on the nature of the change.

For example: the bacterial flora in acid soils devoid of calcium carbonate is very different from that in normal soils, but one cannot point to any reaction that is wholly suppressed in consequence. It was once thought that nitrification ceased, but later work shows that this reaction, sensitive as it is, still goes on, although at a greatly reduced speed,

It has not yet been found possible to connect the change with the agent —to say at a given moment which organisms are playing the most important part at that time.

The obvious method of studying the changes in the soil is to observe the growth of plants, but the phenomena involved are too complex to be readily interpreted.

For our present purpose we can follow the changes in the soil by three methods:—

(1) Measuring the rate at which oxygen is observed or carbon dioxide is given off by the soil.

(2) Measuring the rate at which ammonia or nitrate is formed in the soil

(3) Estimating the changes in numbers of bacteria in the soil.

The first two can be determined as accurately as is desired, but the accurate estimation of bacterial numbers is not yet possible and the values are comparative only; nevertheless they are of considerable value for our work.

First of all we may take it as a general rule that the soil organisms, being living creatures, are dependent on suitable temperature and water supply, that they must have food, and also sources of energy to enable them not only to live but also carry on those reactions which involve the accumulation of energy, or, in other words, resemble the rolling of a ball up a hill. These are general requirements that can safely be predicted of any living organism. In addition there is the special requirement that has been discovered by experiment: the need for calcium carbonate, without which many soil organisms will not act efficiently.

The application of general rules to soil problems is a very treacherous business; it is commonly the unexpected that happens, and experimental confirmation is theretore required at every stage. In order to get at the general nature of the effect of temperature and moisture content on the decomposition process it is necessary to do experiments in the laboratory, where all the conditions can be carefully controlled. Experiments show that the effect of rising temperature on the bacterial numbers is quite different from what one expects: instead of rising, the numbers remain fairly constant up to about 80°F., and then they begin to fall.

In like manner, increases in water content of the soil do not lead to regular increases in bacterial numbers; there is a rise at first, but it is not sustained. So in natural conditions the numbers of bacteria do not show the expected fluctuations in the rise in temperature or moisture content. The discrepancy has been traced to the circumstance that the soil population is complex and is not formed of bacteria only. The figures do not give the effect of temperature or moisture supply on the whole soil population, but only on part of it, and they indicate a competition or a destructive effect. When the soil population is simplified by killing the less resistant forms one obtains much more consistent results. Thus soil which has been treated with mild poisons such as toluene shows the expected increase in bacterial numbers with rise in temperature or moisture.

These facts, and others which need not now be dealt with, indicate that the soil bacteria are subject to the operation of some limiting factor quite distinct from temperature, moisture content, or food supply, and I have in other papers argued that this limiting factor is to be found in the action of some of the less resistant and larger forms, such as the protozoa, which keep down

the numbers of the bacteria. This hypothesis explains all the facts that have yet been ascertained, but so many kinds of protozoa have now been discovered in the soil that it is difficult to pick out the exact offenders and render the hypothesis more precise from the purely zoological standpoint. We shall find, however, that the simplest way of interpreting the phenomena is to recognize the complex nature of the soil population and to admit it in the case of any other population. We shall run into great difficulties if we make the common mistake of supposing that all soil organisms are there for the express benefit of our plants and our crops.

The amount of nitrate production does increase with the temperature, and in this respect it differs from the numbers of bacteria. This is in accordance with expectation; up to a certain point an organism may be expected to do more work as the temperature rises, but the increase is not as great as one would get if the numbers increased as well.

When we now turn to the field conditions and try to follow the production of nitrate in the soil, matters are complicated by the fact that the nitrates produced do not all remain in the soil, but are liable to be washed out or taken up by plants. Analytical determinations, therefore, only give difference between the amount formed and the amount lost; they do not show how much is actually produced, nor give the rate of production that we desire to obtain. For some time we could see no way of getting over the difficulty, but a simple solution was ultimately found. It is evident that if the curves showing the amount of some other substances produced in the same way as the nitrate, but lost in a different way, are of the same general shape as the nitrate curves, then the shape is due mainly to the production factors: if, on the other hand, the two sets of curves are different in shape, then the loss factors control the situation. The carbon dioxide in the soil air satisfies these requirements; it is produced, like nitrates, by bacterial action, but it is lost largely by gaseous diffusion, and only in very wet weather by leaching. Carbon dioxide was therefore determined simultaneously with nitrates, and the curves show a marked similarity except that the increases in nitrate came later. Thus we may conclude that the curves both for nitrate and carbon dioxide are in the main production curves.

The amount of carbon dioxide in the soil air, which, as we have just seen, indicates the rate at which it is produced, follows the soil temperature during the winter months, but not during the summer; indeed, during hot weather the amount is distinctly low. It does not show any very close connexion with the moisture content, but it is more closely related to the rainfall.

Thus it appears that rain does something more than add water to the soil, and an interesting problem is re-opened which has in the past occupied a great amount of attention from agricultural chemists. From time immemorial practical men have felt that rain had a fertilizing effect. Medieval writers attributed it to some ærial spirit or celestial nitre washed down. LIEBIG, more precise, put it down to ammonia. As a result of LIEBIG's support a vast number of analyses have been made of rain from all parts of the world, but all agree in showing that there is not enough ammonia present to make any practical difference.

To what, then, are we to attribute this marked effect of rain? In soil investigations the direct attack is often least effective: it is usually necessary

to work round the problem and see it from another point of view. In this case help came from a rather unexpected quarter. During the course of other soil investigations it was found that soil particles possess two atmospheres: the free atmosphere in the soil pore spaces, and another atmosphere dissolved in the soil water or soil colloids.

Table showing Composition and Volume of Soil Air and Atmosphere.

Soil Air.	Per cent.		
	CO_2	O_2	N_2
Free air	0·4	20·3	79·3
Dissolved air	98·0	—	2·0
The Atmosphere.	0·03	20·97	79·0

The free atmosphere is very much like our own, except that it contains more carbon dioxide; it is eminently suitable for ærobiç organisms. The dissolved atmosphere, however, is entirely different: it has not been fully investigated, but it is known to be almost devoid of oxygen and to consist mainly of carbon dioxide and nitrogen. The fact that it exists in such close proximity to the free atmosphere shows that the oxygen is used up more rapidly than it is renewed, and this means that the plant roots and micro-organisms which are immersed in the soil water are perpetually in need of more oxygen. So far as we know there is no process in the soil that will hurry up this renewal of dissolved oxygen, and plants and micro-organisms alike are perpetually restricted by the lack of it.

Now rain is a saturated solution of oxygen, and when it falls on the soil it not only supplies the needful water but also renews the stock of dissolved oxygen, and thus gives the micro-organisms and the plant roots a new lease of activity.

But the soil is not governed solely by the conditions that happen to obtain at the time being; it is profoundly influenced by those that have passed: indeed, one might go so far as to say that its properties are determined largely by its history. The shape, size, and to a large extent the composition of the mineral particles are the result of forces that caused the fragments of rock to chip off long ages ago, and have governed their wanderings ever since. The nature of the organic matter depends on the past vegetation, and this in turn on the climate; the micro-organic population is determined by vegetation, climate, and other causes. The soil as we see it to-day is the result of changes and climates long since past as well as of those now present. In short, the soil is the embodiment of its past history, and can only be studied properly in the light of its history.

This is equally true of the minor events. Changes in conditions do not cease to be effective as soon as the old conditions are restored; they leave their mark, which may persist for a long time and lead to very unexpected results. Experiments at Rothamsted and elsewhere have brought out the apparent paradox that conditions harmful to life lead to greater bacterial

activity as soon as they have passed, while conditions favourable to life finally cause decreased bacterial activity.

Thus, if a soil is dried for a time and then re-moistened, it becomes a better medium for the growth of plants and of bacteria, the production of nitrates is increased, and the supply of phosphate becomes more available. The bacterial numbers do not, however, undergo any visible change.

Productiveness of Soils stored dry. (Oats: Gedroix, 1908)

No. of years of Storage.	No. Manure.	Complete Manure.	Complete without Nitrogen.	Manure without Phosphate.
0	10·3	83·5	13·5	11
1	17·8	83·9	32·3	19
3	24·6	90·9	23·6	35·4
5	25·0	102·8	32·2	42

When soil is exposed to severe cold there is an increase in nitrate production, and, in this case, in bacterial numbers also. Exposure to heat causes a similar change. Greater growth is commonly obtained wherever a bonfire has been made, and in India it has been the practice from time immemorial to heat the surface of the land before growing the rice crop. Volatile antiseptics are now known to have a like result.

The converse of the rule is also true: whenever a soil is well supplied with organic matter, with moisture, and kept well warmed, the bacterial numbers do not remain as high as might be expected, but on the contrary they tend to come down. After a time these soils fail to produce their full effect and they are said to become "sick." Instances occur in commercial glasshouses run at high temperature where the soil after a season's use becomes unsuitable and is therefore thrown out, all its valuable manurial residues being sacrificed.

Sick soils have been examined in some detail, and the trouble was traced to at least two causes: an accumulation of disease organisms, and also an exaggerated activity of the factor limiting bacterial activity in ordinary soils.—Jour. of the Roy. Hort. Soc.

DETERMINING THE NUMBER OF PROTOZOA IN SOIL.

G. P. KOCH.

The supposed noxious action of the protozoa of the soil with respect to other micro-organisms has drawn the attention of biologists to the protozoology of the soil in its relation to fertility.

The writer remarks on the inefficiency of the methods at present in use for determining the numbers of protozoa and suggests an improvement on the platinum loop method with an average experimental error of about 7 per cent.

Culture solutions were made with extracts of dried blood and soil *(Löhnis)* containing bi-potassium phosphate, inoculated with different amounts of manured greenhouse soil and incubated at 22°C for 30 days. Each day the numbers and types of protozoa were examined.

The maximum number of protozoa varied with the culture solution and the condition and amounts of soil used for inoculation. In dried blood extract the maximum development of all protozoa occurred earlier than in hay infusion, and after the maximum was reached the number of protozoa gradually diminished. Development was also early in solutions to which large quantities of soil had been added, but the number of protozoa per gram of soil was greater when only 1 gram was added instead of a larger quantity. Extract of soil is more favourable to the development of protozoa than dried blood. Dried soil favours the development of flagellates, whilst dried blood causes only a slight difference.

Flagellates are first in leaving the encysted condition and they are much more numerous than the ciliates, which vary in number in inverse proportion to the quantity of manure in the soil, whilst in the extract of dried blood the flagellates developed better with inoculations of heavily manured soil. Numerous types of ciliates are found, but few types of amœbæ.

Another series of experiments, in which extracts of blood and hay infusions were inoculated with greenhouse and field soil, gave analogous results. Hay infusion was a better medium than extract of dried blood for all forms of protozoa, probably on account of the medium being more suitable for bacteria.

To study the effects of various temperatures of incubation, different amounts of soil were inoculated into dried blood extracts and hay infusion and incubated at temperatures from 5° to 30°C for 30 days. In hay infusion the small ciliates develop sooner at the higher than at the lower temperatures. Blood extract and infusion are both unfavourable media for the development of large ciliates, which flourish at all temperatures used if conditions are favourable. Flagellates developed at a lower temperature than the ciliates, reaching a maximum of 6° to 7° in dried blood extract and 15° to 16°C in hay infusion, which is therefore the better culture medium.

In general the development of each species of protozoa depends upon the following factors: the nature of the medium, the quality and quantity of the soil inoculated, and the temperature of incubation.—Bull. Int. Inst. of Agric.

MANGANESE AS A FERTILISER.

Of recent years much discussion has ranged round the question whether salts of manganese are or are not capable of increasing the yield of crops. Yet, in spite of the discussion and of the very numerous experiments made to test the action of salts of manganese, no certain rule for the guidance of the practical grower has been enunciated. That this is so is due not to shortcomings on the part of the investigators, but to the fact that soils differ so much from one another, and are the seat of such complex and contradictory chemical changes, that results obtained with soils of one kind differ absolutely from those obtained when other soils are used. It is probable, indeed, that the experimenters who have been engaged in researches with manganese have been for the most part anxious to obtain results of service to agriculturists,

and that this anxiety, so much in evidence at the present time, has defeated the object which they had in view. Nature only answers simple questions, and the simple questions in the present case have not yet—so far as we know—been put to her. It is true that all plants contain manganese, but it cannot be stated with certainty that manganese is an essential constituent of plants. It is also true, as Bertrand was the first to show, that traces of manganese play the part of activators of the oxidation processes of soils and plants; but it cannot be asserted that the acceleration of oxidation processes is necessarily an advantage to the plant. The plant, like the human tiller of the soil, has a labourer's stroke. It must grow at its own rate, and in its growth oxidation and reduction processes alternate and reciprocate. Wherefore it is probable that the curious and capricious effects of manganese will be explained only when investigators begin their investigations in a scientific spirit, and at the beginning ascertaining first by the classic methods whether a plant can do without manganese, as the textbooks' omniscience says it can, and whether the addition of manganese to nutrient solutions of known and varied compositions produces any positive effect on growth. The most recent investigations of the manganese problem, carried out by Messrs. Skinner and Sullivan (Bull. 42, U. S. Dept. of Agric.,) raise our hopes at the outset, only to dash them at the conclusion. The investigations are as thorough as they can well be. They include experiments with pot-cultures and field-culture, but, nevertheless, the conclusions to be drawn from them are not decisive. Working with Wheats in pots of unproductive sandy loam, Messrs. Skinner and Sullivan find that manganese salts—chloride, sulphate, nitrate and carbonate—all accelerate growth. The increase is most marked in the case of soils treated with manganese chloride, and almost as great in the soil to which manganese sulphate is added. It is moreover, considerable, and up to a certain point progressive. The addition of 10, 25, and 50 parts of manganese chloride per million of soil results in an increase of crop weight of 19, 29 and 31 per cent. A further addition of the salt reduces the effect. When, however, similar experiments were conducted with a productive loam the result of adding manganese salts was negligible—the plants grew as well in the normal as in the treated soil. Experiments made with extracts of soils similar to those used in the previous tests show that in the case of Wheat plants grown in the soil solution from the sandy loam the oxidation power of the plant is increased by the addition of manganese salts, and that in the case of Wheat grown in the extract from a productive loam it is not.

Thus it would appear that in a poor soil the addition of small quantities of manganese chloride or sulphate is likely to lead to increased growth, but that on a fertile soil to add manganese salts is waste of time and money. Unfortunately the field trial made by Messrs. Skinner and Sullivan, though it does not necessarily invalidate this conclusion, does not lend it support. Various crops, Wheat, Rye, Corn, Cowpeas and Potatoes, were grown on a silty clay loam, low in organic matter. The physical condition of the soil was rather poor and the soil was lime-hungry. The result was that in the case of most of the crops the addition of manganese (in the form of sulphate) did not produce any beneficial effect.

The experiments are to be continued, and the acid state of the soil having been remedied by the application of lime, it may well be that the next few years will tell a different experimental tale. In the meantime the enterprising gardener may, if his soil be very poor, try the effect of giving it a very moderate dose of manganese chloride or sulphate, but if it be of good heart he had better leave it alone so far as manganese manuring is concerned.

—Gardeners' Chronicle.

TROPICAL AGRICULTURE IN CEYLON.

REPORT OF THE CEYLON AGRICULTURAL SOCIETY FOR 1915-1916.

(Submitted to the Ceylon Agricultural Society at the Annual Meeting held at Colombo on June 6th, 1916.)

MEETINGS.

The last annual meeting was held on 31st August, 1915, at the Council Chamber when the Hon'ble Mr. R. E. Stubbs, Colonial Secretary, presided. Since then 2 quarterly meetings were held, one at Galle Kachcheri on 30th November, 1915, at which The Hon'ble Mr. R. B. Hellings, Government Agent, Southern Province, took the chair, and the other at Jaffna Kachcheri on 29th February, 1916, when Mr. B. Horsburgh, Government Agent, Northern Province, presided.

Both meetings were well attended and evoked much local interest, proving the wisdom of the decision arrived at on the suggestion of Sir Robert Chalmers that ordinary meetings should be held in rotation at the chief provincial towns. This was specially the case at Jaffna where the gathering was particularly large, representative and enthusiastic, and a number of new members were enlisted. Much of the success of the Jaffna meeting is to be credited to Mr. V. M. Muttukumaru, the Maniagar of Jaffna, whose interest in the welfare of the Society and solicitude for the convenience and entertainment of the visitors to Jaffna deserve special mention.

The more important subjects discussed at these meetings were:

(1) Coconut Cultivation in the Southern Province
(2) Tobacco Growing as a Profitable Industry
(3) The Control of Water on Paddy Lands
(4) The Curing and Fermenting of Tobacco
(5) Cattle Insurance
(6) Dry Farming
(7) The Growing of Dry land Crops under Irrigation.

MEMBERSHIP.

During the period under review the following members joined the Society :— H. Leonard Cox; J. G. Abeydeera; Naito; Mrs. H. L. S. Ingles; Robert & Co., G. W. H. Gordon: A. Thomson; Superintendent, Pulna Burong Estate; F. T. D. P. Guel; S. Chelliah; C. H. A. Samarakkody; M. B. Alawatugoda; Harry Jayawardene; E. V. Gooneratne; E. B. Goonetilleke; D. M. Seneviratne; J. A. Aiyadurai; O. L. de Kretser; A. S. Goonewardene; The Manager, Sanadja Estate; St. V. B. Dowa; Jesus Montenegro: H. F. J. Gardner; Geo. M. Crabbe; Mc. Dougall Bros.; M. G. Keuneman; M. G. Samaree; Manager, Brooklands Estate; Harrisons and Crosfield, S. I.; Mrs. A. J. Pearson; Dr. Chas. Amarasuriya; J. S. Armstrong; Dr. John Rockwood; Lionel P. Edwards; Superintendent, Tirrukkovil Estate; H. D. Garrick; R. de Laval Walker; C. A. Gunaratne; N. E. Wijesekere; Dr. Marcus Rockwood; J. A. Bland; Rev. F. L. W. Wickremesinghe; W. Balasuriya; Chas. Wood; G. M. Alles; C. B. Barber; A. Koch; L. T. Ab Pan; C. P. Dias Bandaranaike; Moulmein Pharmacy;

Le Secretariet Syndicat des Fab Suera; Mg. Thier Nya; H. J. Rodbard: African Lake Corporation; Officer in Charge, Agri. Station, Wiosa; Officer in Charge, Agri. Station. Juaso; Kelantan Copra Co., Ltd.; Mrs. Marian A. Mc Adow; G. Lambe; Taito-Seito-Kaisha; I. H. Pye; L. B. Warakaulle; Mrs. C. M. Mellor; F. D. Samarasinghe; E. Ramalingam; A. Sapapathy; Reginald M. Fernando; Em. Jos. Schram; P. de P. Carey; Secretary, Indian Tea Association; Beynis Freres; Prospect Group of Estates; A. C. W. Samarakoon; W. D. T. Kulatilleke; P. Rajagopal; S. Kandyah; M. Swaminathan; T. Ramaswamy Pillai; T. C. Changarapillai; V. Mudaliyar Chittambalam; J. N. Sandrasegara; V. Chelliah; Dr. S Chinnayah; S. Thambayah Pillai; Regis Rajagariar; John Rodrigo, S. Tisavanathar; Hon'ble Dr. Rutherford; Don Albert Kekulawala; D. Viezee; A. A. Ward; Mudlr. Muttu Wellopillai; K. Balasingham; Dewa Rajan; Hackett Thomson; Director of Agriculture, Jesselton; Director of Agriculture, Kuching; H. Wilkinson; Hon. Mr. Chas. Vanderwall; Mohammed Farid Mounib; Abdul Hafiz Nosay; W. J. Ager; E. M. Wyatt; P. S. Sherdrake; Harold de Zylva; T. W. Oliver; Deputy Superintendent of Schools, Zamboanga: R. A. Dummer; W. A. Muttukumaru; De Handelsvereeniging le Batavia; M. S. Fernando; E. H. M. Wijeyesekera, J. H. Bahar, Mudaliyar; and T. Chellaturai, the total number of members at date being 1,576—890 local and 686 foreign. The foreign members are drawn from England, 71; Scotland, 8; Ireland, 4; New Zealand, 3; France, 13; Siam, 6; Italy, 4; Burma, 37; Java, 44; Japan, 23; Fiji, 4; Belgium, 2; India, 144; F. M. S., 80; Portugal, 3; China, 2; Russia, 2; Cochin China, 5; Africa, 50; America, 25; Australia, 35; East Indies, 6; West Indies, 29; Pacific Islands and Hawaii, 8; New Caledonia, 1; Egypt, 6; Bahamas, 1; Gold Coast, 12; Holland, 7; Dutch East Indies, 9; Philippine Islands, 2; Solomon Islands, 7; Mauritius, 4; Seychelles, 5; Borneo, 14; Uganda, 9; Cook Islands, 1; of Local members, 336 belong to the Western Province: 254 to the Central Province; 72 to the Southern Province; 40 to the Northern Province; 40 to the North-Western Province; 59 to the Province of Sabaragamuwa; 15 to the Eastern Province; 17 to the North-Central Province; 57 to the Province of Uva.

Starting with a membership of about 100 in 1904, the number steadily rose to 1,883 in 1914.

Since the outbreak of the war the names of members who were enemy subjects were deleted from the Society's register, whereby the number was reduced by about 300.

BOARD.

We extend a hearty welcome to Sir John Anderson as President of the Board and feel sure that the Society will make steady headway in its career of usefulness under His Excellency's rule.

During the past year the Society lost one of its Vice-Presidents through the death of Sir Hector VanCuylenburg, M.L.C., who evinced a keen interest in its proceedings and was always ready to assist in any practical measure affecting the welfare of the indigenous population. Sir Hector was specially interested in agricultural education.

The announcement of Mr. John Harward's retirement will be received with sincere regret by all members of the Board. Mr. Harward has been closely associated with the work of the Society since its inception. He served on several Committees and made valuable contributions to the discussions at

Board Meetings. Indirectly he has rendered great service to the cause of agriculture through the hearty support he gave to the School Garden Scheme, which works through the organization over which he presides, and, but for his ready and willing assistance, could hardly have attained to that degree of efficiency which it has reached.

OFFICE.

Some idea of routine work of the office will be indicated by the following figures:—

Letters received	4,445
Letters despatched	4,358
Endorsements	588
Memos, Reminders, &c.	5,400
English Magazines despatched	20,472
Sinhalese Magazines despatched	30,204
Tamil Magazines despatched	1,560
Acknowledgments and Receipts	1,797
Total ...	68,824

As the Society is in touch with Agricultural Departments and Institutions in all parts of the world, a large number of enquiries on matters pertaining to Tropical and Sub-Tropical Agriculture are received from abroad in addition to local communications.

The clerical staff consists of Mr. J. S. de Silva, Chief Clerk, who joined the Society at its inception, and has a thorough grasp of the duties of his office, Mr. W. A. W. Gunawardene, Assistant Clerk and Interpreter, Mr. K. B. Halangoda, 2nd Assistant Clerk, and Messrs. C. A. Samarasinghe and A. Abeyesinghe, Junior Clerks. Mr. W. Molegode, Senior Agricultural Instructor, who is attached to the Secretary's office, is frequently deputed to conduct special enquiries and initiate experiments in different parts of the Island.

STAFF.

The Organising Vice-President presided at a number of meetings in the provinces, chiefly in connection with the Co-operative Credit movement, and enquired into local affairs at different centres. Mr. Lyne's wide sympathies and practical advice have been of the greatest service to the Society.

The Secretary traversed all the provinces of the Island supervising the work of the Agricultural Instructors and inspecting the gardens and experimental plots established by the Society.

The following is a list of the Instructors, the number being kept down owing to retrenchment:—

Walter Molegode, Head Office.
K. Chinnaswamipillai, Eastern Province.
L. A. D. Silva, Sabaragamuwa Province.
M. J. A. Karunanayake, Hambantota District.
A. Madanayake, Galle District.
J. R. Nugawela, Central Province.
A. A. Jayasinhe, North-Western Province.
V. Ramanathan, Northern Province.

The services of Mr. L. de Z. Jayatilleke, Agricultural Instructor, Sabaragamuwa Province, were requisitioned as Interpreter to the School of Tropical Agriculture.

The appointment of MR. CHELLIAH, late Agricultural Instructor, Jaffna, as Maniagar of Delft and MR. P. B. M. BANDARANAYAKE as R.M. of Bintenne (Eastern Province), is a compliment which the Society duly appreciates, and it is hoped that the continuance of the policy of selecting headmen from the Society's staff of instructors will be justified by the improvements which such trained officers should be able to effect in their districts.

FINANCES.

The annexed statement of receipts and payments drawn up by the Society's Auditors covers the period January to December, 1915.

Though the year started with a small debit balance the Society's finances speedily recovered themselves as the result of increased income from subscriptions on the one hand and by retrenchment on the other and in spite of a reduced grant from Government, it was able to vote a sum of Rs. 1,200 for class-rooms for the School of Tropical Agriculture and Rs. 580 on account of extensions to the Office. As will be seen from the Statement of Accounts the year closed with a credit balance of Rs. 16,629·82.

INCREASING THE FOOD SUPPLY.

At a recent meeting of the Low-country Products Association this subject was referred to and strange to say no mention was made of the work done by the Society in this connection.

The Society is the only organisation in the Island with a staff of itinerating officers who are giving all their time to the improvement of native agriculture. They are in constant touch with the rural population, and have special facilities, which they have not been slow to take advantage of, for encouraging the extended cultivation of food crops. The Progress Reports of the Society have during the past 12 years been one long record of work done in distributing seeds of cereals, legumes and other edible crops as well as fruit plants, numbering many thousands. To those who move about the country, particularly in the remoter parts of the Island, the improvement on previously existing conditions as the result of the work of the Instructors, the influence of the Society's Gardens as well as of School Gardens is most striking. In the last Progress Report will be found a reference to Polonnaruwa and in the present report to Balangoda and Ambalangoda as places which supply abundant testimony of the good work that has been done by the Society. During the early days of the War, when a shortage in the food supply was apprehended, the prompt action taken by the Society materially helped to save the situation.

The question of bringing under cultivation the extensive irrigation areas lying waste under the tanks is a separate one and must be considered by itself. What is to be desired—at least as an initial measure—is that these lands should be given at nominal rates to individual capitalists or syndicates on condition that a certain proportion of the area is brought under cultivation every year. We have waited long enough for colonization by small settlers, and it is time a definite liberal policy was adopted, as in Australia, to induce those who have the capital to open up these lands and thus assist to colonise them, so that the Island's resources may be further developed and the railway route better patronised both for passenger and goods traffic.

Too great prominence is being given to paddy as the crop *par excellence* for cultivation under irrigation, and too little attention to other crops which under irrigation can be made to give large yields, as is the case

in India, Egypt and Japan. The Dry Zone Experiment Station at Anuradhapura under the management of MR. D. S. CORLETT has brought this home to us, and proved the possibility of establishing large irrigation farms under the tanks. It is to be hoped that all concerned will profit by the lesson which the Department of Agriculture has taught and that its practical application will be seen before long.

DISTRIBUTION OF SEEDS AND PLANTS.

One of the most important items of the Society's programme of work is the distribution of seeds and plants to members. The regular distributions take place in May and September. During the past year 7,400 packets of seeds and 4,831 plants were issued.

The Society's nurseries at Colombo contained 3,000 plants at the close of last year.

The seed store and nurseries so long associated with the Government Stock Garden in Colombo are now being transferred to the site of the old Silk Farm close to the Peradeniya Railway Junction, where they will be under the close supervision of the Secretary.

The duties of Seedsman to the Society are performed by MR. M. J. FERNANDO, who also holds office as Manager of the Government Stock Garden. I would like to take this opportunity of acknowledging the service rendered to the Society by this officer.

PUBLICATIONS.

The Society's Journal—THE TROPICAL AGRICULTURIST—maintains its reputation as the leading agricultural magazine in the Tropics. During 1915, 21,000 copies were issued containing 1,512,000 pages of actual reading matter.

MR. LYNE, Director of Agriculture, is Editor, with the Secretary as his Assistant, and articles of special interest are also contributed by the members of the Agricultural Department. Progress Reports of the Society are embodied in the Journal, which has every important agricultural magazine on its list of exchanges.

The Sinhalese Agricultural Magazine—GOVIKAM SANGARAWA—is the only local journal of its kind, and as such is very popular. It is now in its eleventh volume and has a monthly impression of 2,900. Copies reach the hands of all Teachers of Government Vernacular Schools, and most Headmen. The Secretary is Editor and is ably assisted by MR. N. WICKREMARATNE, Secretary to the Board of Control, Co-operative Credit Societies.

The Tamil Magazine—KAMAT THOLIL VELAKKAM—is edited by MR. C. H. COOKE. It is not as well supported by the Tamils as the GOVIKAM SANGARAWA is by the Sinhalese.

The more important papers read at Board Meetings are reprinted and distributed as leaflets.

A third edition of the Year Book is in course of preparation and will be issued at the end of the year.

MR. MOLEGODE, Senior Agricultural Instructor, has compiled a useful and handy little book on Vegetable Culture.

The following is a complete list of the Society's publications up to date:—TROPICAL AGRICULTURIST 22 vols., and 11 each of GOVIKAM SANGARAWA and KAMAT THOLIL VELAKKAM and leaflets dealing with the following subjects:—Agriculture in Tamil Districts; A Note on Onion Cultivation; Castration of Cattle; Canker (Nectria) of Para Rubber (Hevea Brasiliensis); A Note on

Chillie Cultivation; Yams (Dioscoreas); Prevention of Plant Diseases by Spraying; Kiushu or Japanese Paddy; On the importance of submitting specimens when reporting injury from Insect Pests; Bud Rot of the Coconut Palm; Hints to Cotton Cultivators; Useful Hints to Growers of Castor-Oil (Eri) Silk Worms; Rice Bug or Paddy Fly; Agri-Horticultural Shows; Shade Trees: their Importance, Instructions for Planting them, etc.; Dumbara Tobacco; Diseases of Tobacco in Dumbara; Use of Salt for Manure; Manioca Cultivation, Dhall; Method of Taking samples of Soil; Transplanting in Paddy Cultivation, The Improvement of Local Races of Plants; A Simple Preventive against Malaria; The Use and Object of Agricultural Societies; West Indian Yams; Conservation of Soil Moisture; Rotation of Crops on Chena Lands; Continuous Cultivation of Chena Land; Coconut Stem Bleeding Disease; A Stem Disease of Coconut Palm; Results on Recent Experiments in Paddy Cultivation; Groundnuts; Arrowroot; Further Notes on Transplanting and Manuring Paddy; Two Valuable Green Manures; Hints to Tobacco Growers; Silk Cotton Tree; Soy Bean; Notes on Grafting and Budding; Sorghum as a Fodder Crop; Some Hints to Village Coconut Cultivators; The Castor Oil Plant; Hints on Bee-keeping; Dry Farming; Fodder for Cattle; Hints on Cotton Cultivation; Continuous Dry Land Cultivation; Plantain Disease; Green Manure for Paddy; Sudan Dura; Address to the Students of the School of Tropical Agriculture; Report on College of Tropical Agriculture.

GARDENS.

The Society's Gardens continue to serve as agencies for the extension of fruit and vegetable cultivation and the dissemination of new and improved varieties of economic crops, in addition to being experimental and demonstration centres.

Through them many lessons have been taught and a great deal of practical experience gained for the benefit of local landowners.

The Garden at MEDIWAKE in Upper Dumbara has for the past four years demonstrated the practicability of continuously cultivating chena land by adopting a modified system of rotation. Through this garden better varieties of sweet potatoes, maize, tobacco and cotton have been introduced, and the cultivation of such new crops as spelt wheat, potatoes and coriander demonstrated.

The BANDARAGAMA Garden is mainly devoted to the cultivation of fruit, and a large and representative collection, numbering about 300, of both local and introduced varieties has been established. It is therefore an important centre for the spread of fruit culture in the south-west of the Island.

BALANGODA Garden has done much useful work in encouraging the cultivation of vegetables, which were notably scarce and dear in this district. Both Native and English vegetables have been systematically raised on a commercial scale and the seed freely distributed, with the result that the supply of vegetables is now plentiful. Such new cultivations as onions, sorghum, cow-pea, soy-bean have also been successfully carried on. The Garden having served its purpose, it is proposed to plant it with fruit trees and hand it over to the local authorities before starting operations in some other little-developed centre such as Godakawela.

The KEGALLA Garden and Park is laid out with ornamental and economic trees, and nurseries of plants for distribution. Seedlings of new varieties of hybrid coffee have been established and land has been cleared for planting them out.

At the WERAGODA Garden which serves the moist south of the Island. both fruit and vegetable cultivation is carried on. As a result of the work going on here the growing of vegetables has become a common occupation, while pine-apple cultivation has been taken up on a large scale. The propagation of the better varieties of fruits, both local and introduced, established in the garden is being successfully done by means of "Gootee" layers.

The AMBALANTOTA Garden is situated in the dry south of the Island. Here the cultivation of cotton and sorghum has been demonstrated and encouraged among holders of chena land, by whom both crops have been taken up and successfully raised. Cotton is admirably suited to the extensive waste lands of the Hambantota district, but in the absence of a local buying agency there is no encouragement to would-be cultivators. Sorghum is proving a desirable addition to the food supply of the district.

PADDY.

The Society's work in connection with paddy may be summarised as follows:—(1) the introduction of new and better strains, (2) effecting exchange of seed, (3) arranging for meeting shortage of seed, (4) demonstrating seed selection and the advantage of transplanting (5) proving the advantages of green-manuring, (6) making trials with improved types of implements.

Not much more than 5 years ago the planting out of paddy seedlings raised in a nursery was the exception in the neighbourhood of Kandy: now it is the common practice as the result of the work of the Instructors. By demonstration and trial plots and by the offering of awards, the cultivators are being gradually weaned from their old ways.

The reluctance to adopt new strains of paddy was at first a serious obstacle, but since the Instructors have won the confidence of the cultivators this difficulty has disappeared.

The cultivation of MOLAGU-SAMBA paddy, introduced from India in the latter part of 1912, has now spread far and wide. It is a fine table rice which suits local conditions, and is therefore a valuable introduction.

A detailed record of the Society's work in connection with paddy cultivation up to the end of 1914 will be found in a pamphlet issued last year. This gives an idea of the extent of the operations, and the results achieved.

Since then seven varieties of PHILIPPINE paddy were received and a first crop raised with the assistance of MR. K. B. BEDDEWELA. Some of these are so highly thought of that they are likely to become as popular as Molagu-samba.

The most recent introduction is a series of short-aged varieties, ranging from 2 to 4 months, procured from Burma, Travancore and Madras to meet the requirements of certain districts.

The growing of sunn-hemp as a green manure crop has been steadily encouraged and the results obtained have been so satisfactory that sunn-hemp is being widely grown for the purpose of manure. At Tissa the crop was doubled when it followed a crop of sunn-hemp, and at Ratnapura and Molegode an increase of 44% was effected by this means.

A "transplanting" demonstration was conducted, at the request of MR. GRAHAM PANDITESEKERA, a landowner of Chilaw district, at Madampe where transplanting was practically unknown. MR. W. MOLEGODE who

supervised the work was able to show a yield equal to 66 bushels per acre raised with 8 measures seed against the ordinary yield of 40 bushels per acre with 2 bushels broadcasted seed.

The following summary of a report of a recent demonstration made by MR. MOLEGODE at Dunuwile, Kandy district, embodies results not previously recorded. Mutusamba (6 months) was cultivated on a field approximately 7/10 of an acre in extent. Selected seed was sown in a nursery and the seedlings when 6 weeks old were planted out in bunches of three, which were placed 6" × 6" apart. The field, after ploughing and levelling, was treated with ordinary village refuse. The paddy attained a height of 6 to 8 ft. and gave a yield of $66\frac{1}{2}$ bushels equal to 95 bushels per acre.

On Suduganga Estate (Matale district) with the co-operation of MR. R. SENIOR-WHITE a field of 1/17 of an acre was planted out with seedlings of Molagu-samba paddy, two seedlings per hole being planted 4 in. × 4 in. apart. The crop was excellent, each bush producing on an average 30 shoots. Unfortunately the crop was badly damaged by field rats owing to the neglected condition of neighbouring fields, and as a result a yield equal to only 25 bushels per acre was secured. A sample of the paddy raised is on view to-day.

On Marakona estate (Matale district) similar experiments in transplanting were conducted in co-operation with MR. A. B. THOMSON, the Superintendent, and proved that it was possible to double the ordinary yield by adopting the methods recommended.

These first experiments on estates will be repeated, and as the fields get settled down and the details of work become more familiar, better results may be expected.

The cultivation of water-resisting paddy obtained from Burma was conducted at Baddegama with the co-operation of MR. D. A. GUNAWARDENE who has furnished the Society with details as to dates of sowing, periods of inundation, etc. The crops gave good promise of resisting the effect of flooding, but the occurrence of an unusual drought nullified the results and more accurate information must await another season's work. Following upon a discussion at the meeting held in Galle, an enquiry was instituted into the circumstances under which fields in tidal areas along the South-West Coast are liable to be inundated by salt water and resulted in the following facts being elicited: (1) Inundation takes place during two seasons of the year, namely in June and December, when the paddy is from 8 to 10 inches high. (2) At such periods the incoming mixture of river and sea water floods the fields and leaves the water standing to a depth of from 4 to 8 inches. (3) The plants in the lowest fields die out as soon as the flood subsides; those in the higher elevations become yellow and give a very poor return. (4) No steps are taken to help the flood water to escape by cutting drains, etc. MR. CORLETT, Manager of the Experiment Station, Peradeniya, kindly undertook to consult the Ministry of Agriculture, Cairo, with a view to ascertaining what action was taken under similar circumstances in Egypt. The reply received was to the effect that no rice was cultivated under precisely similar conditions, but that salt lands were reclaimed for cultivation by deep ploughing and washing out the soil, so that the salt in it is precipitated to a lower level or passes out in solution into the drains cut low for the purpose of keeping the land sweet. If the drains are not cut low the salt is liable to again rise up.

The construction of dams to keep out brackish water would seem the most satisfactory, though expensive, way of meeting the difficulty.

In Western India special strains of paddy are cultivated on saline lands, and one of these (Dodki) is being grown experimentally in the Jaffna district by the AGRICULTURAL INSTRUCTOR and MUDALIYAR C. M. SINNAYAH.

COCONUTS.

The stoppage of trade with enemy subjects and the temporary dislocation caused by difficulty in securing freight caused considerable inconvenience for a time, but did not affect commercial confidence in the industry.

During the first quarter of 1915 the price of copra ranged from Rs. 70 to Rs. 81 per candy; in the second quarter it fell as low as Rs. 46; in the third it went up to Rs. 60; while in the fourth the price fluctuated to an extraordinary degree, rising to Rs. 94 in December but falling again to Rs. 75 before the close of the year.

The exports of copra during the year aggregated 1,098,174 cwt.; of coconut oil, 473,425 cwt.; desiccated nut 37,844,694 lb.; poonac 184,897 cwt.; coconuts 5,443,677; yarn and fibre 277,104 cwt.

Two lots of San Ramon coconuts have been imported by the Society at the request of enterprising members. PROF. COPELAND in his standard work on the Coconut describes this nut as very large and productive and states that the average production, year after year, is 1 picul of copra from every 200 nuts which is equivalent to 818 nuts per candy.

Some 250 nuts received on the order of the Society have been distributed among 12 members, the largest number going to MESSRS. C. NAMASIVAYAM, Colombo, V. CASIPPILLAI of Jaffna and F. J. DE MEL of Moratuwa, who received 50 and over each.

The introduction of this excellent variety of the coconut is a notable event in the history of the industry.

TOBACCO.

The possibility of our producing a tobacco good enough for the European market is receiving the close study of MR. SCHERFFIUS, who has now worked through two seasons in the North.

It is to be hoped that he will next turn his attention to Dumbara and Matale districts, where tobacco cultivation is fast extending and the prospects of growing a superior leaf for export purposes are distinctly promising.

SORGHUM.

The experimental cultivation of Sorghum *(S. vulgare)* was first taken up by the late Colombo School of Agriculture as far back as 1888, when it was regularly grown in the students' plots and found its way from there to the chenas; but it was never taken up in earnest and only appeared in highland cultivation as one of the ingredients in the mixed crops which generally characterise chena lands.

Sorghum vulgare is known by different names in various countries where slightly differing strains of the cultivated species are found. It is the Giant Millet of India, the Guinea corn of the West Indies, the Dhura of Egypt, the Kaffir corn of South Africa, the Broom corn of Italy, and so on.

In India it occupies some 25 millions of acres and is important not only as a grain but also as a fodder crop, and in the dry condition it is the stand-by of the cattle owner whenever there is a shortage of pasture.

The successful cultivation of Egyptian sorghum by MR. CORLETT, Manager of the Experiment Station, Peradeniya, led to a revived interest in this crop, and by the distribution of seed through the Society its cultivation is being encouraged and a fairly large extent devoted to it in the drier districts for which it is specially suited, e.g. Hambantota, Jaffna, Batticaloa, Trincomalee, Anuradhapura, and parts of Badulla and Kandy districts. The people have yet to acquire a taste for the grain and adopt it in their dietary in preference to Kurakkan and other small millets they have so long been accustomed to. A paper on Dhura Cultivation by MR. CORLETT is available as a Society leaflet and applications for seed and instructions for planting should be made to the Secretary.

LAC.

In 1911 the Society, on the suggestion of PROF. DUNSTAN of the Imperial Institute, sent an Agricultural Instructor (Mr. N. WICKREMARATNE, now Secretary to the Board of Control, Co-operative Credit Societies) to the Agricultural Research Institute, Pusa, to study lac cultivation. On his return experiments in the cultivation of the Indian lac insect *(Tacchardia lacca)* were set on foot with the hearty co-operation of Mr. K. B. BEDDEWELA who rendered valuable assistance in this connection by offering trees on his estate for inoculation and also personally supervising the operations. The lac produced as the result of these experiments was distributed among lacquer workers in the Kandy and Tangalle districts, and some lacquered articles on view to-day have been prepared with this lac. A fresh lot of brood lac has been indented for from India, and further inoculation work in Jaffna, Kurunegala and Tangalle will be undertaken on its arrival. The lacquer industry has recently been in a very depressed condition owing to the difficulty experienced by the workers in procuring lac, which has hitherto been collected from the jungle, but it is to be hoped that the Society's efforts to establish lac on such common and practically useless trees as Kön (*Schleichera trijuga*) and Masan (*Zizyphus jujuba*) will result in its revival.

SERICULTURE

Silk worm rearing has been practically given up except by the Salvation Army in connection with the Home for Vagrants in Mutwal.

The industry was never seriously taken up in the villages, though for a time the efforts of the Society resulted in temporary activity in this direction, particularly among school children.

The mulberry plantation on the late Silk Farm (now the site of the Government Stock Garden and Society's Seed Store and Nurseries) is still maintained and will be available for feeding and propagation purposes whenever sericulture comes to be revived. The breeding of both the mulberry worm (*Bombyx Mori*) and the Eri or castor-feeding worm (*Attacus Ricini*) is kept up on a small scale to meet any demand that may arise for eggs. Recently a case of cocoons was despatched to the Philippines at the request of the Department of Agriculture there.

APICULTURE.

Bee-keeping is practically confined to the rearing of the tropical honey bee (*Apis indica*) which is a good honey producer and takes readily to the box hive. There is, however, still much to learn about its manipulation particularly in checking its propensity for swarming which often takes place

unexpectedly and causes great disappointment to the bee-keeper. The manufacture of comb-foundation with the aid of the machine specially made for the Society in America, has undergone considerable improvement as the result of experience, and applications have been received for the material both locally and from India. Specimens of foundation are on view to-day. Applications for hives and swarms continue to be received at intervals, but when those who grow fruit crops – whether a commercial product like coffee or orchard fruit like oranges—fully realise the important part played by the bee as a fertilising agent, the rearing of bees according to modern humane methods and the gathering of honey without wanton destruction of bee-life, should become as common a home industry as poultry-keeping.

AGRICULTURAL EDUCATION.

Since the last annual meeting was held a School of Tropical Agriculture has been opened and is now at work at Peradeniya, the more ambitious scheme for an Imperial College having been postponed for a more favourable season

There are at present 72 students on the register, about half of whom are provided with hostel accommodation.

It will be recalled that the first steps towards the opening of a School or College of Agriculture were taken by the Society which has closely identified itself with the subject of agricultural education. In the equipping of the school the Society was able to provide two temporary class-rooms at a cost in material and money of not less than Rs. 1,500.

The appointment of the Organising Vice-President as Principal and the Secretary as Vice-Principal is a further link to bind the Society to the School.

The training of a number of Government vernacular teachers at the School will ultimately qualify these officers for teaching elementary agriculture to the village school boy through text books and School Gardens and thus widen the present scope of the School Garden Scheme which is doing such excellent work.

A senior agricultural reader, supplementary to the junior reader published in 1914, was prepared by the Secretary and has been adopted in Government Vernacular Schools.

IMPROVEMENT OF LIVE STOCK.

A good deal of work was done in the early days of the Society with the assistance of the Veterinary Department to eliminate as much as possible the undesirable males in village herds.

The improvement of stock by means of good breeding sires has however been so long left to private owners of live stock who have done much in this direction, but village cattle especially in outlying parts of the Island have received little attention.

In 1914 the Society by way of experiment imported a pedigree Kangayam bull through the Madras Department of Agriculture, and after keeping it for a time in Jaffna moved it to Ambalantota, and then to Mahaoya. The offspring of this animal is evidence of what is possible even on a small scale in improving the ordinary type of village cattle. Further efforts of this nature are desirable, and the purchase of selected bulls for particular areas (e.g. Delft) is under consideration.

With the formation of Co-operative Credit Societies in villages there is better opportunity for organising the improvement of cattle by employing suitable stud bulls.

Through the initiative of DR. H. M. FERNANDO, a scheme for the improvement of village poultry, through the agency of teachers in charge of School Gardens has been set on foot—the funds for the purpose being generously provided by him.

The HON. SECRETARY of the CEYLON POULTRY CLUB who was consulted with reference to this Scheme and kindly offered any assistance he could afford to make it a success, wrote as follows:—

> "I am very pleased to see something is being done to improve poultry throughout the villages. There is already a very marked improvement in poultry kept by natives in all up-country districts. This can be noticed motoring through the country, and I put it down largely to the efforts of members of the Ceylon Poultry Club who have I hear given a large number of eggs and birds to coolies on estates."

AGRICULTURAL SHOWS.

The Society since its formation has organised a long tale of Shows, but since the All-Ceylon Exhibition no Agricultural Show was held—chiefly owing to the war—till last April. The Nuwara Eliya Show which used to be an annual event did not take place last year, but this year a small Exhibition chiefly of flowers, fruits and vegetables was held on April 24th and 25th and was practically confined to the town and its environs. Though the classes were not as full as they might have been, many of the exhibits were of a high order. The Exhibition was opened by H. E. SIR JOHN ANDERSON.

An Agricultural and Industrial show to be held at Jaffna next year is on the cards, and if the proposal materialises this will be the first held in the Jaffna peninsula, and should prove an interesting exposition of what the industry of the inhabitants of the North can produce under tolerably hard natural conditions.

There is not likely to be another big show while the present political troubles last.

VILLAGE AGRICULTURAL UNIONS.

With a view to working hand in hand with the cultivator in order to effect the improvement of his crops the Society is initiating a system of Agricultural Unions—particularly in the remoter districts—through the agency of its Instructors.

The following note will give some idea of the working of these Unions.

Each Union will control a limited and compact number of villages and work a small farm of its own for which the land will be leased or acquired. The capital of about Rs. 500 will be raised by means of, say, Rs. 10 shares of which each member must take at least one.

(1) A small area of about an acre for testing new varieties which the members in consultation with the Agricultural Department may wish to try.

(2) The rest of the land to be devoted to the raising of pure seed of the variety which is proving most satisfactory.

The activities of the Farm will be devoted to the chief crop of the locality.

The produce of the seed of the Farm will be sold each year to the members, each of whom will reserve a part of his own land for growing the seed from the Union Farm and reserve the produce for his own use. By this means each member will be increasing his supply of good seed so that in time the whole of his land will be sown with the best available seed calculated to produce the highest yield.

The Union will consist of members who reside not further than a specified radius, say 5 or 6 miles. The Farm will be controlled by a Committee and be in direct charge of a Manager responsible to the Committee. A simple set of accounts showing receipts and expenditure will be kept.

The Union should be registered as a Co-operative Union under the Registrar of Co-operative Credit Societies, in which case it will have its accounts properly audited.

A reserve fund will have to be formed to provide for *(a)* partial failure of crops, *(b)* renewal of stock live or dead, *(c)* contingencies of any kind.

A similar system of Unions tried in North India is working well and helping to improve the wheat crop.

The Farm will be the means of introducing new varieties and demonstrating new methods.

The chief element of success in the working of the Farm is that every member of the Union will have a personal interest in its success or failure for if it makes a profit he benefits thereby and vice versa.

Specific details (size of farm, capital, value per share, etc.) will of course be influenced by particular localities, but the principles of the system will be the same everywhere. The greatest care will have to be taken that the element of risk (particularly in trying new crops and methods) is reduced to a minimum, and that as far as possible the success of any undertaking is assured. The main object in view should be to benefit the great mass of cultivators by effecting the improvement of seed which receives practically no attention. By means of these Unions the village cultivators will be co-operating for their own benefit.

PESTS AND DISEASES.

The cordial relations existing between the members of the Agricultural Department and the Society has made it possible for the members to avail themselves of the expert advice which the scientific officers can afford them.

The Acting Entomologist, MR. GEORGE HENRY, whose advice was the most frequently sought, reported on various pests causing damage to paddy, mango, orange, cinnamon, tobacco, sorghum and vegetables, and the Society rendered assistance to those in need of help to carry out remedial measures. Full particulars of these pests and the treatment suggested are embodied in the Progress Reports and reproduced in the TROPICAL AGRICULTURIST.

It is much to be regretted that no practical means of fighting the plantain disease which first appeared in 1914 have yet been discovered.

A landowner who has given special attention to plantain cultivation writes:—

> "I am sorry to say that the imported plantain varieties you were kind enough to give me from the Stock Garden some time ago, are no more, having been attacked by the plantain blight, and the two varieties I sent to the Stock Garden seem to have shared the same fate. I had about 22 varieties of plantains on my estate at Talangama and there are only just a few remaining owing to the blight, to eradicate which we have up to date found no effective treatment."

CO-OPERATIVE CREDIT SOCIETIES.

All the spade-work in connection with this movement was done by the Society before a staff was appointed in 1913 with MR. R. N. LYNE

as Registrar and Mr. N. Wickremaratne as Secretary. In 1914 a largely attended conference was held at the King's Pavilion, Kandy, presided over by His Excellency Sir Robert Chalmers. There are now 55 registered Societies with a membership of 4,800 and a paid-up capital of a little over Rs. 25,000. The main object of these Societies is to help the villager by lending him money at a low rate of interest to efficiently carry on his agricultural pursuits. Much good has also been done by local Societies purchasing and retailing manure to members on easy terms. During 1915 and in the first quarter of 1916 about 81 tons of manure purchased at a cost of about Rs. 8,450 have been distributed among the members by 12 Societies. The bulk of the manure was for paddy land.

Several of these Societies are interested in the improvement of paddy cultivation and with the assistance of the Agricultural Society are making trials with new strains of seeds, in transplanting, etc. The starting of gardens has been proposed by more than one Society, and it is hoped that these will be established before long. In India the question of amalgamating the departments controlling Co-operative Credit Societies with the Agricultural Departments has been under consideration. In Ceylon the Government anticipated this idea by appointing the Director of Agriculture as the head of the Co-operative Credit movement.

Owing to local and foreign disturbances this movement has not progressed as much as it should have done during the past year.

It is to be hoped that the members of this Board will do everything in their power to increase the number of Co-operative Credit Societies and thus help those who are in real need of assistance.

A RETROSPECT.

The Society was founded by Sir Henry Blake in 1904 and was, so to speak, set on its feet by Sir Henry McCallum.

The first Secretary of the Society was Mr. E. B. Denham, c.c.s., who held office for two years during which time he did yeoman service. He was succeeded by the late lamented Mr. A. N. Galbraith, c.c.s., who acted for 6 months, after which the post was held for a short space of 2 months by Mr. T. A. Carey, c.c.s. In 1907 the present Secretary was appointed in addition to his own duties as Superintendent of School Gardens.

Since then the staff of instructors, originally 3 in number, was increased to 12, but owing to retrenchment the vacancies created by the appointment of instructors to other posts have not been filled up, and at present the number is down to 8.

The work carried on through the Society's gardens, as well as through the instructors and the Sinhalese Agricultural Magazine has created a keen and intelligent interest among native cultivators in everything pertaining to agriculture which, if that were all achieved, is in itself a great work.

In its instructors the Society possesses a number of trained and tried officers whose knowledge of the cultivating classes and the conditions under which they live and work as the result of close and frequent contact with them, is of the greatest value in attempting to carry on any work of improvement.

I would specially commend their case to the sympathetic consideration of the Board, inasmuch as it was not dealt with by the late Salary Commissioners, and would urge that their scale of emoluments be revised and their prospects so improved as to be in keeping with the times and commensurate with the value of the technical services rendered by these officers.

C. DRIEBERG,

6th June, 1916. Secretary, Ceylon Agricultural Society.

TROPICAL AGRICULTURE UNDER IRRIGATION.

(Paper read before the Annual Meeting of the Ceylon Agricultural Society, June 6th.)

In several of the oldest civilised countries of the world, vast tracts of land that once supported a teeming and prosperous population have fallen back into their primeval state of desert, marsh or jungle. In such countries as Egypt, Mesopotamia, and Ceylon, this has been probably caused by the failure, for one reason or another, of their great irrigation works, created when the nations concerned were at the zenith of their power.

Since those days Egypt, under British administration, has been entirely restored to her former state of wealth and prosperity by the restoration of her Irrigation Works. Mesopotamia, under the desolating rule of the Turks, still lies waste; but the day is perhaps dawning when she too will resume her power with the reconstruction of her irrigation. Now let us briefly see what has been done in Ceylon, and what could be done, to restore her northern provinces, which were once the richest in the East, back to their former wealth.

Here in the Northern part of the Island lies a vast tract of jungle-land in a semi-dry zone, receiving rain in only one monsoon. The soil is fertile and mostly flat and capable of irrigation from the great artificial tanks built 1500 years ago and since neglected and ruined. Under various administrations, since that of SIR HENRY WARD in 1855, the Government of Ceylon has spent large sums of money on the restoration of many of the greater tanks and their channels, as well as the smaller village tanks they feed.

The sum thus invested is a large one and the annual expenditure on upkeep of the works is considerable, but the income derived is small in comparison.

With this fertile land and abundant water the return on the irrigation works might perhaps be made to show a profit.

The schemes of restoration have had for their object the improvement and extension of paddy-cultivation by native cultivators—partly for the relief of the scattered villagers already in possession of land and partly to induce settlers from other provinces. A later idea amongst planters on a larger scale is that Ceylon should attempt to reduce the price of imported rice from India and Burma by planting up the vast areas in paddy.

The importation and the price of rice is ever on the increase, to feed the increasing population, whilst the home cultivation of paddy is on the decrease.

But the price of rice can never be ruled by what could possibly be produced in the limited areas of the paddy fields of Ceylon. The price must be ruled by the vast areas of India and Burma where it can be produced at a cheaper rate. Just so is the price of wheat controlled by Russia or Canada, or cotton by America.

In order to insure the financial success of modern irrigation works, they should produce staple products of high value, besides less profitable crops such as paddy and other grain.

In Egypt the cultivators look to pay their taxes, water-dues and heavy cultivation expenses from their lucrative crops of cotton or sugar-cane, leaving the crops of paddy or maize as net profit.

But the native goiya of Ceylon has very little knowledge of proper cultivation under irrigation. It would take generations of tuition before he would adopt modern methods or could be induced to make his land produce more than just sufficient for his own needs.

We have before us the example of what has happened under Tissamaharama Tank in the South. For twenty years the natives have been cultivating this fine, large area of good soil and abundant water, yet we find a most poor form of cultivation producing a quarter of the crops it is capable of producing. Labour is scarce and the settlers are beset with difficulties.

And nowhere in Ceylon—save perhaps in Jaffna—is there a surplus population seeking an outlet for its energies in taking up and cultivating new lands reputed unhealthy and requiring a considerable outlay in preparation before they are fit for cultivation.

Thus it would appear that the successful settlement of these valuable lands by the unaided efforts of the goiya of Ceylon is not likely to take place.

Let us then see what alternatives could be adopted.

If we abandon the idea of paddy cultivation alone, what crops suitable to irrigation and the climate remain?

It has been proved at Maha-iluppalama in the centre of this district, that the coconut palm, under proper cultivation and with irrigation, can be successfully grown. The palms take from six to eight years to bear, but meanwhile there is a wide field for catch-crops available.

At the New Anuradhapura Experiment Station, which two years ago was a waste of jungle, is now to be seen a large variety of valuable economic products. Tobacco; Robusta coffee; Sugar-cane; Cassava; Arrowroot; grain and Leguminous crops of all kinds; Citrus; and other fruit trees, and many other products. There is also the possibility for cocoa and oil palms.

To establish any or all of these products successfully would entail considerable expenditure in clearing, levelling and preparing the land and creating field-canals and drains subsidiary to the main irrigation channels. Secondly some time must elapse before a profitable return on the outlay could be expected.

It is, therefore, obvious that either the aid of the Government or the capitalist must be called in.

Firstly there is the Planting Company. The objection to this scheme that has been raised is that it only benefits the capitalist and the Tamil labourer, to the exclusion of the Sinhalese.

But when once plantations are established with hygienic, mosquito-proof lines, work will be found for inhabitants of neighbouring villages, and labour from the Eastern Province and Jaffna will be readily attracted. Plantations must mean employment for educated Ceylonese and openings for traders of all kinds.

Secondly there are Land Companies. Those in Egypt have done a great work in forwarding the prosperity of the people and adding vast tracts to the domains of Egypt and the Empire. And as such they have received every support from the Government. But in Egypt there is a large population to settle on new lands and before any such company ventured in Ceylon either an indigenous or Indian immigration must be assured to settle on the land when developed. The company prepares the land—a matter of several years—and establishes it in crops of paddy, dura, sorghum, legumes and other local products. The land is then leased to native cultivators and gradually sold to them together with the hygienic villages built by the company.

In 1912, I understand that practical proposals had been put forward for developing land under some of the tanks, though I do not think anything has as yet come of them.

DUDLEY S. CORLETT,

6th June, 1916. Manager of Experiment Stations, Ceylon.

THE FUTURE OF RURAL AGRICULTURE IN CEYLON.

(*Paper read before the Meeting of the Ceylon Agricultural Society on June 6th.*)

The agricultural industries of the Island fall under two distinct heads, viz.: the Planting industry, which deals with the growth of products on an extensive scale for purposes of export, and the rural Agricultural industry, which is concerned with the growth of food crops required for the immediate use of the people. Rural agriculture in the aggregate deals with a larger area of land than that devoted to Planting products. The production of rice, dry-grains, vegetables and fruits is mainly confined to the peasantry who are small land-holders.

Rural agriculture has admittedly failed to progress with the times; in the main the same crops are grown and the same methods practised which were in vogue for hundreds of years. There is little progress to record. On the other hand owing to various economic changes in the country, the conditions under which these operations were carried out have considerably altered. The area of land available for cultivation is becoming restricted; the forest reserves which were available to the cultivators have been appropriated; the extensive tracts of pasture land for cattle have disappeared; and ancient village systems and methods of co-operation no longer exist in their original form. Rural agriculture has gradually become less profitable and the production of the soil has appreciably decreased.

The improvement of the methods of rural agriculture is a problem that still awaits solution. Various attempts have been made during the last thirty years to induce the cultivator to better himself, but the measures adopted to this end have not met with any marked success.

It will be interesting to recall some of these measures—

1. The restoration of irrigation reservoirs.
2. The establishment of a School of Agriculture in Colombo.
3. The teaching of agriculture in village schools.
4. The opening of experimental gardens.
5. The introduction of new crops.
6. The introduction of new breeds of cattle and the opening of a Dairy.
7. The establishment of the Ceylon Agricultural Society.
8. The organization of the Department of Agriculture.
9. The Scheme of School Gardens.
10. The introduction of the Co-operative Credit movement.
11. The founding of a School of Tropical Agriculture.
12. The working of an experiment station in the Dry Zone.

Some of these measures have been abandoned, others are still in existence and are being worked with the knowledge of past experience.

A number of irrigation reservoirs were restored at great cost and, in the case of two or three schemes such as those of Kalawewa and Tissa, a fairly large area of land has been brought under cultivation; but in other places such as Minneriya and Giant's Tank the land has not been taken up to any appreciable extent. The School of Agriculture established in Colombo in 1884 was discontinued after a few years as it failed to attract the proper

class of students. The teaching of agriculture in village schools was abandoned as not being of a sufficiently practical character. The Experimental Gardens opened from time to time were given up as they failed to interest the public. New products such as Cotton and Groundnuts were introduced as cultivations likely to benefit the rural population, but they never gained a footing. The Government established a dairy farm and also introduced new breeds of cattle from India. These did not result in any great extension of dairy farming or improvement of native stock, on account of the absence of suitable pasture land in the villages.

The agencies which at present aim at the improvement of the village cultivator are the Ceylon Agricultural Society with its staff of instructors and the Department of Agriculture which controls School Gardens, Co-operative Credit Societies, the School of Tropical Agriculture and the Dry Zone Experiment Station.

The causes of failure of some of the measures adopted for the improvement of rural agriculture deserve careful study in deciding the future agricultural policy of the country.

The causes of these failures may be broadly summarized under the following three heads:—

1. Much of the experimental work and instruction failed to influence the cultivator as they were in many instances adopted without an intimate knowledge of the rural population and belonged to an entirely different system of farming and different conditions of rural life.

2. The village cultivator has no capital or credit to enable him to carry out improvements in his system of cultivation and he has generally no means of earning money by engaging in subsidiary industries which at one time enabled him to supplement his income.

3. The system of rural administration under which the villager is placed has made him so dependent on outside assistance and interference in his affairs, that he has fallen into a state of lethargy and inactivity through which he has lost his powers of initiative and originality.

In any scheme for the improvement of rural agriculture in Ceylon measures should be directed to remedy these fundamental drawbacks. The Indian Department of Agriculture after several decades of experience has organised its staff of expert officers, with a view to enable them to gain as much intimate knowledge of rural conditions as possible. The experts who have received their training in the West are associated in each of their departments with deputies and assistants, who are natives of the country. These assistants are not foremen or members of a subordinate class of officers but are qualified men who act as colleagues and whose emoluments, status and education entitle them to a position little if at all inferior to the experts appointed from Europe. If the Ceylon Department of Agriculture will follow this Indian precedent it will greatly add to its value and usefulness.

The Tropical School of Agriculture recently started at Peradeniya has recognised the importance of imparting agricultural knowledge to the rural population, and has made provision for teaching the subjects in the vernacular where necessary. The English-speaking students who have joined the school belong to a class that is interested in the planting rather than in rural agriculture, whether as estate owners or as employées. Rural agriculture will have

to depend mainly on the students taught in the vernacular. Great encouragement should therefore be given to attract these latter students in large numbers. All vernacular teachers should be given a finishing course at this institution and sons of rural headmen and owners of village lands should be encouraged to attend the school by being granted free tuition and lodged at a cheap rate. The second difficulty which has been mentioned—the lack of capital and credit among the village cultivators—should be met by an organised effort for reviving village industries and encouraging them in every possible way. Societies similar to the Kandyan Art Association should be started in every important centre, and receive strong local patronage.

The Department of Agriculture is taking a keen interest in the formation of Co-operative Credit Societies and these efforts should be recognised by the public and every help afforded to make the scheme a success. As regards the third drawback, it is important that an exhaustive and careful investigation should be undertaken in regard to methods of rural administration so as to discover and remove the causes that have led to the stagnation of rural enterprise. The village cultivator should if possible be freed from the benevolent interference which has made him so passive and apathetic, and be urged to realise his responsibilities and shape his destiny through his own effort.

The Ceylon Agricultural Society through the untiring efforts of its Secretary and the sustained interest taken in its development by the Organising Vice-President and the other officers of the Society has without doubt been instrumental in creating very wide interest in agricultural matters in this country, and has opened the way for much useful progress in the future.

W. A. DE SILVA, J.P.

Colombo, 6th June, 1916.

THE AGRICULTURAL POSSIBILITIES OF DELFT.

(*Paper read before the Annual Meeting of the Ceylon Agricultural Society.*)

Delft (called the Long Island by the Tamils) is about 25 miles from Jaffna and 16 from Kayts, that is as the crow flies, but not as the boat sails. Indeed the journey to and fro has a spice of adventure about it, since it is seldom that the wind favours both the outward and inward bound passenger, and as likely as not what should be a journey of hours is sometimes prolonged by adverse winds to one of days.

The Island, which like the Jaffna Peninsula is of coral formation, is about 18 square miles in extent and nearly twice as long as it is broad.

The peculiar system of land tenure in Delft, unlike that of any other part of Ceylon, is thus referred to by MR. J. P. LEWIS, late Government Agent of the Northern Province, in his Notes on Delft (Royal Asiatic Society's Journal, Vol. XXII, No. 62):—

> "The island is the property of the Crown, and the people are tenants of the Crown; but the term of occupation is of indefinite duration, and no rent has ever been imposed or recovered, except for dry grain cultivation on the plains. Notwithstanding the fact that the inhabitants who occupy lands are merely tenants-at-will, they have during British

times at least been accustomed to make and receive transfers of these lands and to give dowries of them by notarial deed, as if the dominion was vested in themselves and not in the Crown. Up to the present year in Delft no lands had ever been sold by the Crown by public auction. In 1905 I recommended that some lands be put up for sale, and I am glad to see that course has now been taken, and some acres were put up for sale this year (1908)—the first sale of Crown land in Delft by public auction."

The characteristic perennial vegetation is similar to that of the Mainland and consists of the palmyrah palm planted in irregular groves. The palmyrah supplies the people with most of their wants.

Coconut cultivation is carried on on a limited scale, and in 1905, 50 candies of copra, 20,000 nuts and 10,000 cadjans were exported from Delft to Jaffna. Since then the area under coconuts has increased, and every inducement should be given to further extend the cultivation of the palm which with better attention ought to yield very good returns.

Annual food crops consist of tobacco, paddy and the following dry grains :— Sami *(Panicum miliare)*, Varaku *(Paspalum scrobiculatum)* and Mondy *(Panicum Crus-galli* var., *frumentaceum)*.

Tobacco occupies a small acreage, and by selecting sheltered situations, and giving careful attention to details good leaf is produced for the Jaffna market.

Paddy cultivation is also of limited extent and is, of course, rain-fed.

The bulk of the cultivated land is under dry grains occupying between 2,000 to 3,000 acres, and there is a possibility of introducing better varieties of high land crops which stand drought well. With a view to popularising the Egyptian variety of Sorghum known as Dhura, the Agricultural Society distributed seed in time for planting last season and during my stay in the Island (March 2nd to March 5th of this year) I made a point of inspecting the results and awarding a prize for the best crop.

In an account of the cyclone which swept over the Islands in 1814 reference is made to the damage done to crops of wheat and hemp. If there is no mistake about the identity of wheat, this suggests the possibility of growing the crop, a variety of which introduced from S. India has been raised with success in the drier part of Upper Dumbara. I propose to send seed of this spelt wheat to Delft for next season's planting.

The hemp referred to is probably sunn-hemp (*Crotalaria juncea*) found under cultivation in Jaffna and Chilaw and not Indian hemp (*Cannabis sativa*). Sunn-hemp is a source of fibre used for making fishing nets, and is also an excellent green-manure crop.

Cotton, which was at one time grown systematically, is now not cultivated. A degenerate form of the coarse short-staple Tinnevelly variety, of an extraordinary hardy character, grows promiscuously as a perennial, and the poorer classes pick the cotton and spin it into yarn which is used for making sail cloth. While in Delft I saw the ginning and spinning done, and am showing to-day a series of specimens from seed cotton to the fabric. Before the next planting season the Maniagar will receive an ample supply of seed of a hardy variety, such as Cambodia Cotton, which should give a better yield and produce better yarn.

A minor industry—if it could be called one—is the collection of a plant found growing wild on the Island known in Tamil as Kavoti, in Singhalese as Bodi, and botanically named *Psoralea corylifolia*. The plant is found in other parts of Ceylon but is nowhere held in such high estimation as in the North where its virtues as a green manure for tobacco are highly appreciated. Licenses to collect the plant are issued at Rs. 4 each license, and a boatload of dry Kavoti fetches as much as Rs. 100. An examination of the plant by the Government Agricultural Chemist was made for the Society. In the sun dried state the percentage of organic matter was 79·13 and of this 2·56% was nitrogen. An analysis of the ash showed 22·18% of potash and 26·30% of lime. The Government Chemist reports:—"It will be seen from above figures that the plant contains a fair proportion of nitrogen in the sun dried state. The best green manures contain about 3% nitrogen. The ash is present in the plant in large proportion, but it will be seen from the ash analysis that the sand and insoluble amount to over 25% of the total ash, showing that a good deal of soil adheres to the plant after washing, so that to arrive at the true percentage of ash in the plant, the percentage of ash ought to be reduced by about 25%, and the constituents in the ash analysis ought to be increased by that amount. The plant is a greedy feeder of potash and lime, and would be useful in drawing supplies of potash and lime from the subsoil which would be given to the surface soil when the plant is mulched as a green manure.

Writing in 1903, MR. J. P. LEWIS remarks there is an excess of cattle in Delft, and states that in 1903 there were about 5,500 head of cattle, 3,000 sheep and 2,000 goats.

In the Jaffna Gazetteer, published recently, the figures given are 5,644 cattle and 3,980 sheep. I am inclined to think that the numbers are greatly in excess of these. The omission of goats (of which there are a few thousand in the Island) is strange. The small number of buffaloes in Delft is remarkable. MR. J. P. LEWIS gives the number as 137 and the Gazetteer does not mention any. At present there are probably less than a hundred but they are good specimens. The males are said to be in demand and to their removal is probably due the paucity of numbers.

That the number of cattle is excessive there is no question, but the degeneration of the stock is due I think more to promiscuous in-and-in breeding than to the inadequacy of the pasture. It is desirable that something should be done to check the progress of this degeneration which, as MR. J. P. LEWIS remarked in 1903, is reducing the cattle to the size of large dogs.

The demand for sheep and goats unfortunately does not extend to cattle. To effect improvement a weeding-out of about half the number, representing the worst types, should if possible be carried out in the first instance, and of those left all the young males except the best should be emasculated when about a year old: but what would be better still is to eliminate all bulls of breeding age in the process of weeding out, periodically emasculate all male calves and introduce a number of suitable stud bulls. These stud bulls should be carefully selected. It will not do to introduce Sind or other large stock. To begin with young animals of comparatively small build, but hardy and active, should be mated with the undersized cows. It may be possible to procure

animals of this type locally, from Panadure or other districts where a fine type of small bull is to be seen: if not, they could be brought over from India.

I would commend these suggestions to the Government Agent of the Northern Province who can count upon the co-operation of the Society in any steps he may take for the improvement of cattle in Delft. A similar course might also be adopted with regard to sheep and goats.

Delft has always been associated with the breeding of horses, which was begun by the Portuguese (who called it the Isle of Horses) and continued by the Dutch. After a period of neglect the British Government took steps to revive horse-breeding at the end of the eighties but finally abandoned the attempt in 1906. The decision to do so was probably arrived at on the advice of the Government Veterinary Department under whose supervision the breeding operations were conducted.

The 25 or 30 animals left on the Island are a great improvement on the old type of Delft pony.

The most interesting feature of Delft is undoubtedly its pasture lands, nearly 5,000 acres in extent. There is probably nowhere in Ceylon such a luxuriant growth of nutritious grass.

Some people have an idea that the natural herbage in Delft is mainly composed of what is commonly known as "Delft Grass." This latter is a species of Cymbopogon (*C. polyneuros*) containing an essential oil with the odour of anise. It probably was named after Delft owing to its having first been noticed there. It is by no means common there and occurs in other parts of Ceylon. The pasture in Delft is composed chiefly of a very fine variety of *Cynodon dactylon* or common horse-grass which grows with extraordinary vigour and covers the ground like a pile carpet. The grazing areas suggest a supply of underground moisture enabling the grass to preserve its luxuriance, which probably arrested the attention of the Portuguese settlers of the North. One cannot think of any means of improving upon this natural pasture, and the only cause for regret is that better control is not exercised over the stocking of the land with a view to making the best use of, and securing the best results from, these rich grazing areas.

The common method of enclosing land (not seen elsewhere in Ceylon) is by means of dikes or stone walls as seen in parts of Scotland and Ireland. These dikes are very roughly constructed of chunks of coral stone, placed one on top of the other, and in this way large rectangular paddocks for live-stock and smaller circular ones for cultivation purposes are constructed.

There are many other interesting features worth noting about this quaint little Island but they would be out of place in a paper written from an agricultural standpoint.

I am glad of the opportunity afforded me of visiting Delft, and I entertain the hope that with the local administration in the hands of a Maniagar who has had an agricultural training and was till recently an officer of this Society, the agricultural possibilities of Delft will be steadily extended with such assistance as this Society will be always ready to afford him in the elaboration of any practical schemes calculated to develop the resources of the Island.

C. DRIEBERG,

6th June, 1916. Secretary, Ceylon Agricultural Society.

AGRICULTURAL IMPROVEMENT IN HEADMEN'S DIVISIONS.

(Paper read before the Annual Meeting of the Ceylon Agricultural Society, June 6th.)

When Sir Henry Blake in 1904 founded the Ceylon Agricultural Society and signified his personal interest in its welfare, the chief headmen of the districts vied with each other in promoting the objects of the Society. Among these were Gate Mudaliyar WICKREMARATNE, late of Weligam Korale, and MAHAWALATENNE RATEMAHATMAYA of Balangoda, who as members of the Board read papers embodying the results of their work in their own particular districts. Both these officers did excellent work for the Society by establishing branch Agricultural Associations, organising shows and competitions, opening experimental gardens, and in many other ways.

My duties first as an Agricultural Instructor and later as Secretary to the Board of Control, Co-operative Credit Societies, have brought me into close contact with the chief headmen of the Island, and I have been thinking that a few notes embodying my experience of what improvements a headman interested in his division could effect, by referring to a concrete case, may suggest to other chief headmen ways and means of doing similar good work.

My first visit to the Kalutara District was in 1907 (when the late MR. J. CONROY whose loss we deplore was Assistant Government Agent) in connection with a paddy transplanting experiment under the supervision of the then Totamune Mudaliyar, MR. J. V. G. JAYAWARDENE, J. P. Since then I have been in touch with the District, attending village shows, conducting ploughing demonstrations and more recently organising Co-operative Credit Societies.

MR. CONROY'S successor, MR. G. F. PLANT, took the greatest interest in all questions pertaining to education and agriculture and it was no doubt he who fired the enthusiasm of MR. J. A. WIRASINHE, Mudaliyar of Rayigam Korale. This Korale is one of the largest chief headmen's divisions in the district with an area of 83,200 acres and a population according to the last Census, of 591,889. The extent under Paddy is 13,130 acres, Rubber 11,570, Tea 5,722 and Coconut 19,210. There are also Cinnamon and other low-country products, while vegetables are cultivated on an extensive scale.

A beginning in the improvement of village agriculture was made by the starting of a branch agricultural association in 1907, the members contributing to form a fund for establishing an experimental garden, any balance left over being devoted to procuring copies of the GOVIKĀM SANGARAWA the Sinhalese magazine of the Agricultural Society, to be supplied to members

In the year 1907 the garden was opened with a grant from the Parent Society equal to the sum locally raised, in accordance with the principle that help is only given to those who help themselves. The garden is over 5 acres in extent, occupying a central situation (Bandaragama). It is mainly devoted to fruit culture, but contains other economic products, green manure plots and nurseries for the distribution of plants. The collection of fruit trees is large and representative and includes several grafted plants introduced from abroad. To make the place both attractive and useful an ornamental garden and a circuit bungalow were provided, the cost of the latter being met from the Gansabawa funds.

Four village shows held in the district for a number of years gave a great impetus to the cultivation of fruits and vegetables. A feature of these shows was the distribution of money prizes for the best kept compound in each village with a view to the improvement of rural sanitation. They were also made the occasion for the presentation of a shield for the best school garden of the year.

The latest phase of agricultural work in the Korale is the institution of Co-operative Credit Societies of which there are four. These societies help the cultivator financially to carry out improvements in his cultivation. The four societies are situated in convenient centres, viz., Wewita, Horana, Galapatha and Handapangoda. They have 455 members and the paid up capital is Rs. 4,093. Loans are made for various agricultural and industrial purposes. Meetings are held regularly and are presided over by the Mudaliyar, who has the co-operation of his headmen and others who have volunteered to work for the cause. The services of four teachers of village schools have been engaged as honorary secretaries, and the treasurers are men of good status. The committees are made up of the most intelligent headmen and prominent men in the village. Hitherto the villagers purchased their bone-manure for paddy from village boutique-keepers without any guarantee of its purity. Since 1915 the four societies have distributed among the members not less than forty tons of pure bone-manure purchased at moderate cost. One of these societies has just obtained a loan of Rs. 1,000 on interest at 4½ per cent. per annum repayable within 10 years in annual instalments. These societies should go a great way to release the masses from the thraldom of the usurer, inculcate the principle of thrift and self-help, and put a stop to reckless borrowing which has been the ruin of the cultivator. Apart from the material benefit there are also moral and social advantages enjoyed by the people.

In effecting all this the chief headman has been of invaluable service, and without his influence and willing help the task would have been a hopeless one. SIR ROBERT CHALMERS said at the Co-operative Credit Conference held in 1914, "I remind the Chiefs and Headmen that they are given rank and position, not for their own benefit, but in order that their influence for good may shine forth among those with whom their lot is cast. I will only add here that good services rendered in the formation and effective working of Co-operative Credit Societies will not go unnoticed by Government when occasion arises to appraise merit and recognise good work done for the public welfare. . . . . . ." "I should like to conclude with a few words of recognition of those to whom is due the credit of such success as has been hitherto achieved. I begin with the Chiefs and Headmen, because, being leaders of the people they were naturally appealed to for assistance. In most cases the appeal has been answered loyally and generously, and they have laudably identified themselves with the success of village societies."

In conclusion I would urge the chief headmen of the Island—whether of the low-country, Kandyan or Tamil districts—to do all in their power to bring within the reach of the rural population in their divisions the benefits which the Agricultural Society and Co-operative Credit Societies have to offer them, and thus emulate the excellent example which the Mudaliyar of Rayigam Korale has set.

N. WICKRAMARATNE,

6th June, 1916. Secy. to the Board of Control,

Co-operative Credit Societies.

POULTRY.

COMMON DISEASES OF POULTRY.

B. F. KAUPP.

This Bulletin (Bull. No. 233, North Carolina Agric. Expt. Stn.) has been compiled by the Director of the Laboratory for Poultry Investigations and Pathology, Animal Industry Division, North Carolina Experiment Station, West Raleigh, and is especially intended for practical poultry keepers. The treatments recommended are the result of the writer's experience.

Against poultry lice (*Menopon biseriatum* and *M. pallidum* on chickens; *Gonoides stylifer* on turkeys; *Lipeurus baculus* on pigeons) a very effective insect powder is made by taking crude carbolic acid one pint, and gasoline three pints, mixing with sufficient plaster of Paris to make a slightly moist mixture, then rubbing it through a sieve. Let it lie for about two hours when the powder will be found to be dry. If not used at once it must be kept in a well closed can. A bird thoroughly dusted with this mixture need not be redusted for three months.

Against the large head louse (*M. biseriatum*), a good treatment is to grease the tops of the head with plain vaseline or lard if the chicks are young, while older birds are best treated by either dipping in a good coal tar dip or by dusting with an insecticide.

Against mites, cleanliness, disinfection and dusting with the insect powder mentioned above are recommended.

Against scaly legs, soak the scabs with warm water; then with a brush remove all scabs possible, after which scrape with a dull knife. When the legs are dry, saturate with gasoline. Repeat this treatment every five days. A hot solution of lime and sulphur dip has been used with excellent results.

Internal parasites:—

The large round worm (*Ascaris inflexa*) is present in over 25 per cent. of the birds purchased on the market. As a preventive measure the yard and fowl house must be kept clean. As treatment the birds should be made to fast for 24 hours, then give each bird one teaspoonful of olive oil and one teaspoonful of turpentine separately.

The tape worm is treated by fasting the birds 24 hours and then giving them a teaspoonful of turpentine and a tablespoonful of Epsom salts dissolved in hot water. If it is desired to avoid medicating each bird separately, give three grains of powdered arecanut to each bird in a mash made of wheat sorts.

The gape worm forms clusters in the trachea of many birds and it is treated by extirpating them by means of a doubled horse hair or by a feather dipped into turpentine.*

Contagious diseases.—Black head or *enterohepatitis* affects turkeys and more rarely chickens. For its treatment permanganate of potash may be

*Ch. Voisellier (*Aviculture*, Enc. Agric. Paris, Bailliere, 1909, p. 425) states that 95 per cent. of the cases can be cured by subjecting the affected birds to fumigations of sulphurous acid or carbolic acid.

used in the water. Sulphocarbolates of calcium, sodium and zinc in equal parts have given good results in doses of half a grain of the mixture three times a day for each bird.

Fowl cholera.—Intestinal antiseptics are indicated. Permanganate of potash can be used as recommended under black head. Also the three sulphocarbolates are valuable, as well as a solution of one part of bichloride of mercury in ten thousand of water.

White diarrhœa caused by *Bacterium pullorum* has been successfully controlled by the sulphocarbolates mentioned above.

Chicken-pox or sore head may be treated by touching the sores with carbolic acid or with iodine or kerosene. Sick birds should also be given a tablespoonful of castor oil.

Roup or *avian diphtheria* is a highly contagious disease, and if the bird affected with it is not a valuable one it is better to destroy it. If it is desired to treat it the nasal canal must first be syringed with a 20 per cent. solution of bicarbonate of soda to dissolve the mucus, then with equal parts of peroxide of hydrogen and water so as to cleanse thoroughly the parts, after which the following mixture should be injected:

Oil of thyme 30 minims, oil of eucalyptus 20 minims, menthol 10 grains, oil petrol 2 ounces. All these liquids should be warm. The ulcers in the mouth are to be touched with a stick or nitrate of silver.—BULL. INT. INST. OF AGRIC.

EXPORTS OF CEYLON PRODUCE.

The large increase (142,700 lb.) in the exports of cardamoms is extraordinary in view of the diminished demand and the difficulty of selling any but the higher grades at a profit. The spice has already suffered by the war, and we look for diminished exports in 1916, as the tendency is to reduce the planting area. Citronella oil shows a revival, being 249,640 lb. more compared with 1914, which was a poor year. The exports of cinnamon were as follows (lb.):

		Quills.	Chips.	Total.
1914	...	2,361,994	1,498,464	3,860,458
1915	...	4,123,433	2,045,287	6,168,720

The above figures show the remarkable increase of 2,308,262 lb. of quills and chips, which is well distributed among the importing countries, the U.S.A. being the largest consumer of quills (1,416,965 lb.), the United Kingdom receiving 1,333,123 lb.; but of chips the U.S.A. received only 57,828 lb., against the 1,280,870 lb. for the United Kingdom. Spain was a large consumer, with 951,589 lb. of quills and 213,860 lb. of chips. Coconut-oil shipments were well maintained, but copra declined, the United Kingdom imports dropping by over 22,000 tons in 1915. Both Denmark and Holland took increased quantities, and up to the close of the first quarter of 1915, there is every reason to believe, the bulk of these non-contraband goods went through to Germany, but this business practically ceased with the formation of the Netherlands Overseas Trust.—CHEMIST AND DRUGGIST.

CO-OPERATION.

THE CO-OPERATIVE MOVEMENT.

VLADIMIR SAVITZKY.

This year marks the beginning of the second half-century since the foundation of the first Co-operative Association in Russia.

Russian co-operation saw the light during an epoch of great reform—the emancipation of the serfs, the introduction of the Zemstvos, and the reorganisation of the judiciary. Following the first Loan and Savings Association established in Kostroma province by the brothers Luginin, the local landlords, the first societies of consumers arose in Riga and Tomsk. In other northern provinces several cheese dairy associations speedily followed. From these nuclei grew that mighty popular force which Russian co-operation represents to-day.

In 1895 a new type of credit co-operative organisation—"Credit Association"—was created, in which the place of share capital is taken by a loan from the State Bank or local Zemstvo. Loan-savings (share) Associations are diffused principally in those regions of Russia where the population is more well to do; while credit associations predominate in the poorer eastern provinces. A distinctive trait of Russian consumers' societies is that they not only provide the peasantry with necessary commodities, but also organise the sale of various products manufactured by the peasantry. Since 1905 the co-operative movement has been a popular one. In the towns not individual intelligent groups, but the residents themselves—officials, workmen, clerks, etc.—have entered upon the organization of consumers' societies. In the villages not merely the teacher or the landlord, but the people themselves are everywhere organising their labour associations. Since 1905 the co-operative movement has developed with gigantic strides. The total of this development in quinquennial periods is shown below:—

	Number of Consumers' Societies.	No. of Credit, and Loan and Savings Associations.
1865 ...	2 ...	—
1870 ...	73 ...	11
1875 ...	92 ...	514
1880 ...	117 ...	995
1885 ...	175 ...	1,189
1890 ...	260 ...	1,276
1895 ...	482 ...	1,330
1900 ...	897 ...	1,500
1905 ...	1,804 ...	1,620
1910 ...	6,799 ...	6,679

For the quinquennial period 1905-10 the co-operative movement made an advance five times as great as that for the entire preceding 35 years. A vivid

idea of the growth of co-operative societies is afforded by the following comparative data:—

—		On Jan. 1, 1910	On Jan. 1, 1912
Small agricultural societies	...	137	2,345
Butter Unions (*artel*) in Burma	...	51	1,554*
Loan and Savings Association	...	743	2,561
Credit Associations	...	94	5,523
Consumers' Societies	...	600	6,100
Total		1,625	18,083

THE FIRST UNION.

For the decade the number of associations increased more than ten times. Concurrently with this quantitative growth of the co-operative movement both the internal organization and co-operative consciousness of these institutions are developing. The co-operative bodies of various types unite round them all the more enterprising, cultured, and sensible elements of the population. In 1901 the first union of credit co-operative societies arose in Berdiansk, and in 1911 five of such unions, embracing 98 associations, were counted. At the same time, the unions received permission to accept deposits and issue loans, while at Moscow the People's Bank was founded—a central organization of co-operative credit institutions which counts among its shareholders nearly 1,500 co-operative associations. In 1914 the turnover of this bank reached 110,000,000 roubles (£11,610,000). Incidentally, it has organised the sale of eggs and flax abroad. Just as this bank constitutes an amalgamating organization for credit co-operations, so the Moscow Union of Consumers' Societies, with a turnover of 10,000,000 roubles (£1,050,000) annually, serves as a similar centre for consumers' co-operative bodies.

The Yekaterinburg Union of Credit and Loan and Savings Associations furnishes an interesting example of the growth of co-operative amalgamation. The union is still a young institution. Commencing its activity in 1906 with a complement of only sixteen associations, and possessing considerable means, the Union has gradually grown into a powerful organization now consisting of seventy-five associations. The turnover of the Union, which in 1907 amounted to 43,436 roubles (£4,500), in 1914 had attained the sum of 4,517,456 roubles (£476,000). At Yekaterinburg there has been built at the expense of the Union a co-operative palace, thoroughly up to date, with premises for shops, warehouses and printing offices. The Union is deservedly the pride of the co-operative bodies of the Urals.

SIBERIAN ASSOCIATIONS.

The above-mentioned butter co-operations in 1908 formed the Siberian Union of Butter Artels, which now comprises 330 separate organizations, with a turnover of 15,000,000 roubles annually (£1,570,000). More than half the quantity of Siberian butter is manufactured by co-operative butter associations.

Besides the chief office at Kurgan, offices of the Union have been opened in a number of Siberian towns. Inasmuch as the Union sells butter principally in England, it has a permanent bureau in London. A considerable improvement of technical appliances has assisted the development of the co-operative butter business, and Siberian butter has now taken a lasting

* About.

place on the world's markets. Less important unions of dairy associations sprang up at Riga, Yuriev Vologda, Petrograd, and Moscow.

In other branches of agriculture are diffused co-operative associations for the acquisition of agricultural instruments and machinery. Attempts are also being made to organise the sale of fruit, dried vegetables, and eggs upon co-operative principles, while the organization of potato factories by the societies is proceeding fairly successfully. In the south several co-operative flour mills have been built, and in other places elevators for grain products.

OTHER SOCIETIES.

Concurrently with the above-mentioned butter co-operative associations in Siberia, several organizations of this kind in the north of European Russia are of interest for England, for example the Union of Tar-works Artels of Archangel province, through which is carried on the sale of tar manufactured by the local peasantry. Moreover, the Union has organised eleven factories for the production of resin and turpentine. This organization, like many others, disposes of large resources, and possesses its own houses, warehouses, river steamers, barges, etc.

Of recent years the growth of the co-operative movement has proceeded exceptionally rapidly; co-operation is ever more widely and deeply penetrating into the economic life of the country, and ever new types of co-operative societies are springing up. It is interesting to note the formation of such societies among the Ostiaks in the depths of the Narym region, among the Karanagaits of the Terek province—the inhabitants of which are only just beginning to pass from a nomadic to a stationary form of life—and among the Bouriats of the Trans-Baikal province.

How widely co-operation has taken hold upon the masses themselves can best be attested by a series of individual examples depicting the significance of co-operation in the life of some region or other of illimitable Russia. In the Kostroma province, for example, rural co-operation embraces 33 per cent. of all householders of the province. In Yaroslav province the percentage of householders united through co-operative organization has already risen to 50, while in Tula province it amounts to 65.

STATISTICS.

In absolute numbers the significance of co-operation for individual regions is shown as follows:—In Orel province, for example, co-operation embraces 244,000 persons, in Tambov 293,620, and in the region of the Don Cossacks, 350,000.

In Russia at the present time there is a total of more than 35,000 co-operative societies, and according to numbers Russia will soon occupy first place in this movement. Already in membership, which is close upon 12,000,000 she has overtaken all western countries. Reckoning an average family, whose head is a member of society, at from four to five persons, we find that the number of inhabitants interested in co-operation amounts to between 40 and 50 millions—i.e., about one-third of the population. But independently of the number of members, Russian co-operation, judged by its economic turnover, is impressive. The turnover of loan and savings and credit associations on July 1st, 1914, amounted to 773,162,600 roubles (£81,600,000), while the associations had capital of their own amounting to 96,000,000 roubles (£10,130,000), Governmental resources amounting to 48,000,000 roubles

(£5,000,000), and other funds placed at their disposal amounting to 48,700,000 roubles (£5,140,000).

The budget of all the co-operations of Russia totals many milliards of roubles—i.e., exceeds the budget of all Russian towns, Zemstvos, and industrial organisations, and is less only than the State Budget.

The Moscow People's Bank, ever increasing its turnover, is becoming the recognised all-Russia centre in the business of purchasing articles of productive consumption and the sale of agricultural products and articles of handicraft.

EFFECTS OF THE WAR.

The war has not disturbed Russian co-operation; on the contrary, it has given a fresh impetus towards further development, and in connection with the mobilization of the country the co-operations are serving the cause of the Imperial defence. They succour refugees, care for the families of Reservists, supply the population and the Army with food products, and purvey clothing and munitions for the Army. The common cause has strengthened the desire of the co-operations for closer union.

The co-operative association has now reached the village—the centre of all public life. Upon the association the Zemstvo relies in its undertakings; to the association the State appeals when it wishes to summon the people to the task of State defence; the association in the village is now the most energetic vehicle of cultural enterprises.

In the near future it is proposed to promulgate a new law in accordance with which will be established a simplified procedure for the creation of co-operative societies in place of the existing one, which is attended with numerous complicated formalities, and there is no doubt that then the co-operative movement will attain still wider scope.—THE TIMES RUSSIAN SUPPLEMENT.

A NEW HYBRID YELLOW WHEAT.

G. GAUDOT.

A new wheat, named "Ceres," has been obtained by crossing Yellow Briquet with Autumn Victoria in the experiment fields of MESSRS. DENAIFFE at Carignam. Having grown for some ten years under very variable conditions of soil and climate, it has always shown great constancy together with strong constitution; it is perfectly hardy and has remarkable rust resistance. This hybrid is, in nearly every point, clearly intermediate between its two parents; it is semi-late, tillers well, producing fairly long and firm straw, quite white when ripe.

Its characteristics are as follows: ears white, rather elongated, semi-compact, not tapering at the summit; spikelets arranged somewhat in the form of a fan with short, much inflated glumes, completely filled by the grain, which is medium-sized, short and very full, and bright yellow in colour.

This wheat, while giving a heavy crop of straw and grain, and extremely regular in its growth, is not exacting and suits all moderately fertile soils. The great strength of its straw also allows of its being grown on rich soils. Ceres seems from its pedigree and parentage to be likely to be one of the varieties that are really resistant to straw blight.—BULL. INT. INST. OF AGRIC.

GENERAL.

MR. H. F. MACMILLAN, F.L.S., F.R.H.S.

MR. HUGH FRASER MACMILLAN, who has left Ceylon on well-earned leave, completes this month 21 years in the Ceylon Government service.

During that time he filled the post of Curator of the Royal Botanic Gardens, Peradeniya, and has acted periodically as Superintendent of the Hakgala Gardens during the absence on leave of MR. WILLIAM NOCK (now retired), who will long be remembered in the Island for the excellent work he did in Nuwara Eliya and its environs.

With the re-organization of the Peradeniya Staff under the scheme for an Agricultural Department formulated by MR. R. N. LYNE, the Director of Agriculture, MR. MACMILLAN was appointed Superintendent of Botanic Gardens in Ceylon with a Curator to assist him at Peradeniya.

During his 21 years' service in the East MR. MACMILLAN has made a thorough study of the flora of the Eastern tropics in which he was aided by his knowledge of the Vernacular languages acquired soon after his arrival in the Island; and as the fruits of his experience he has produced his HANDBOOK OF TROPICAL GARDENING AND PLANTING which has become a standard work of reference.

A photographer of no mean order, MR. MACMILLAN'S studies of plant life are in great request both for local and foreign publications.

In addition to his regular duties MR. MACMILLAN is lecturer on Economic Products at the School of Tropical Agriculture. He is the author of an excellent illustrated guide to the Peradeniya Gardens, and has written numerous bulletins for the Department of Agriculture, papers for the Agricultural Society and articles for the TROPICAL AGRICULTURIST.

The Peradeniya Gardens of to-day owe much of their beauty and attraction to his trained and artistic eye which has also brought him into prominence at our Agricultural Shows.

We take this opportunity of wishing MR. MACMILLAN a safe voyage to and from England.

THE ARBORETUM AT PERADENIYA.

The well-known Botanic Gardens at Peradeniya provide a most favourable locality for the representation of the principal tropical plants, having regard to the striking differences of the climate and distribution of rainfall prevalent in Ceylon. Situated at an elevation of 1550 ft. above sea level, an average temperature of 76 deg. and an average rainfall of 88 inches well distributed throughout the year, it is possible to establish with a fair degree of success practically all representatives of the wet tropical and intermediate regions, but the purely equatorial species demand a lower elevation and a warmer climate.

The Arboretum, situated at the north end of the Gardens, comprise some 48 acres, in which a representative collection of trees and shrubs of Ceylon and other tropical regions has been brought together and grouped in their respective natural orders, the planting and nomenclature following as closely as possible the lines of BENTHAM and HOOKER'S *Genera Plantarum*. The best

flowering and ornamental species of the respective orders have been planted near the River Drives to add as far as possible to the attractions of the Gardens to the visitor.

Two vistas, originally opened in 1898, traverse the arboretum in different directions, one opening up the magnificent view of the slopes and peak of Hantane (4,117 ft), and the other commanding a fine view of Gangoruwa hill. These at the same time have the additional advantage of facilitating inspection of the collections.

The arboretum is labelled throughout with brick labels, the top half of one side of the brick being sloped and smoothed, and the letters printed in white, on a black background. These have the advantage of being cheap and proof against attacks by white ants, etc., but require renovating about every two years or so. The more permanent method of lead labels as adopted at Kew would be a great advantage here, but is impracticable owing to the pilfering habits of coolies.

In the notes that follow reference is made to the more important specimens (with special reference to the more recent introductions) to be found in the arboretum, with short descriptions and as much information as should make them more interesting to the student as well as to the casual visitor.

1. *Monodora tenuifolia* (Anonaceæ): A beautiful flowering tree of tropical Africa, introduced into Peradeniya in 1897 from Kew, 20 to 30 ft. high, bearing large flowers 2 to 4 in. across, outer petals pearly or greenish white, marked with deep red. Flowers here in April at stage of young growth.

2. *Pangium edule* (Bixaceæ): Native of the Malay Archipelago where it is known as "Pangi," introduced into Peradeniya in 1891 from Java. A very large tree with immense heart-shaped leaves, yielding a hard solid wood.

The seeds contain hydrocyanic acid, but can be eaten after long soaking to dissipate this.

3. *Shorea selanica* (Dipterocarpaceæ): A large tree, native of the Moluccas, which yields a strong and valuable timber. A good specimen of this tree can be seen on the left of the Peradeniya Gardens entrance gate, measuring nearly 100 ft. in height and unbranched for 45 ft.

4. *Kokia Rockii* (Malvaceæ): introduced into Peradeniya from U.S. Department of Agriculture in 1913, and reported to be a beautiful tree of Hawaii, where it has become almost extinct. It is also stated that there are only three living specimens of this tree in existence.

5. *Ochroma Lagopus* (Malvaceæ) A large tree, native of the W. Indies and Tropical America, and known as the "Cork" or "Wool tree," introduced into Peradeniya in 1884.

Quite a useful tree for shade or ornament, bearing long, brown woolly fruits. The wood is very light, spongy and soft, and is used for floats, canoes, etc. The seeds are embedded in wool, the latter being used for stuffing pillows and cushions.

6. *Sterculia acerifolia* (Sterculiaceæ): Native of S. Australia and commonly known as the "Flame Tree," owing to its bearing large masses of brilliant red flowers, introduced into Peradeniya in 1882. Thrives better at higher elevations. Flowers here in February.

7. *Luehea speciosa* (Tiliaceæ): A small tree native of Brazil and introduced into Peradeniya in 1909 from Kew. Of semi-scandent habit and very handsome when in flower. The wood is white, very light, but close grained, and is used to a great extent in Brazil for musket stocks and wooden shoes. The bark of other species of this genus is used for tanning purposes.

8. *Balanites Manghamii* (Simarubaceæ): An oil-producing tree of the dry regions of Portuguese East Africa and introduced into Peradeniya in 1914

from Kew. A tree attaining a height of 45 to 60 ft., of forbidding aspect, bearing large thorns. Said to yield 40 to 50 lb. of seed annually from which 60 p.c. of fine oil is obtained suitable for lubricating and manufacturing purposes, and similar to the finest olive oil.

9. *Evodia elegans* (Rutaceæ): Native of New Guinea. An ornamental tree or shrub, introduced into Peradeniya in 1900, and bearing pretty snow white flowers. Used as a hedge plant, and proves very useful and ornamental as such.

10. *Casimiroa edulis* (Rutaceæ): A small tree of Central America, introduced into Peradeniya in 1899 from California. The tree is cultivated in Mexico for the fruit which is edible and has an agreeable taste, but is said to induce sleep and to be unwholesome. The seeds are poisonous and the bark bitter. The bark, leaves and seeds when burnt are used medicinally in Mexico.

11. *Quassia Amara* (Simarubaceæ): "Surunam Quassia." A shrub native of Guinea introduced here about 1853. The original Quassia of the MATERIA MEDICA and the one upon which the reputation of Quassia as a medicine was established. The bark wood has very bitter properties.

12. *Cedrela odorata* (Meliaceæ): "West Indian Cedar," a well known tree of the West Indies and Mexico, introduced into Peradeniya in 1884. Yields a valuable light wood which is considered the best for cigar boxes, as it cuts freely, is durable, and has a pleasant smell.

13. *Sapindus saponaria* (Sapindaceæ): The Soap-berry Tree. Native of tropical America and West Indies, and introduced into Peradeniya in 1881. A small tree, the berries of which, containing Saponin, form a lather in water, and are sometimes used as a substitute for soap. The black seeds are sometimes polished and used for making necklaces.

14. *Harpullia pendula* (Sapindaceæ): "Tulip wood of Australia." A moderate sized tree of Queensland, yields a valuable timber, strong and durable, and is used in Australia for all kinds of cabinet-work. Introduced into Peradeniya in 1883.

15. *Sclerocarya caffra* (Anacardiaceæ): A handsome tree, bearing large coriaceous leaves, native of South Africa, where it is known under the name of "Morula," and introduced into Peradeniya in 1901. The seeds are edible. Grows well at Peradeniya, but has not yet flowered.

16. *Erythrophlœum guineense* (Leguminosæ): Known as the "sassy bark" of Sierra Leone, native of West Tropical Africa, and introduced here in 1902. A large tree attaining a height of 60 to 100 ft. The bark yields a powerful poison, used as an ordeal, and the red juice obtained from the tree is also used for its poisonous properties.

17. *Brya Ebenus* (Leguminosæ): "Jamaica Ebony." A small tree native of Jamaica and Cuba, and yields a good timber. The heartwood turns black with age as with the true Ebony, and takes a beautiful polish. The "Cocus wood" used for flutes, etc., is supposed to be produced by this tree.

18. *Pithecolobium unguis-cati* (Leguminosæ): A large shrub or small tree of Tropical America and West Indies, and introduced into Peradeniya in 1908.

The bark has astringent properties, and is used considerably in native medicine. It is also used as a hedge plant in the West Indies, being kept clipped to a height of about 5 ft. and is most effective, proving a good barrier as such.

19. *Dipterix odorata* (Leguminosæ): "Tonquin" or "Tonga Bean." Native of Tropical America and introduced into Peradeniya in 1881. Grows to a great size, and yields a most valuable timber. The fruit is one seeded, these being the Tonga beans of commerce used in perfumery, snuff, etc. The

flowers are very fragrant and are used by perfumers. The tree grows well at Peradeniya, but has not yet seeded.

20. *Dimorphandra Mora* (Leguminosæ): "Mora." A large tree, native of British Guiana and introduced into Peradeniya in 1881. An excellent timber obtained, being hard and durable, is used for cabinet work. The tree attains a height of 100 to 150 ft., and is often unbranched for half the height, and bears exceptionally large seeds.

21. *Baikea insignis* (Leguminosæ): A medium sized tree, native of West Tropical Africa and introduced into Peradeniya in 1902 from Kew, 30 to 40 ft. high, bearing remarkably large white flowers about 6 in. or more in diameter. Flowered here in 1913 for first time, and again in 1915, but has not yet fruited.

22. *Gustavia insignis* (Myrtaceæ): Native of Colombia and introduced to Peradeniya in 1884. A small tree, much branched, possessing great beauty both in foliage and in flower, the latter being nearly 5 in. in diameter, with cream white petals, at tips a rose colour, numerous stamens with filaments rose colour towards apex and anthers orange colour. A remarkably pretty tree. Flowered at Peradeniya in 1901 and again in 1915.

23. *Bertholletia excelsa* (Myrtaceæ): "Brazil Nut." Native of Guiana and introduced to Peradeniya in 1880 from Kew. A large handsome tree, common on the banks of the Amazon and yields the Brazil nut of commerce. Bears large, handsome leaves 16 to 20 in. long, and large hard-shelled fruits, 6 in. or more in diameter, each fruit containing 12 to 20 seeds. The tree takes about 14 months to ripen its fruits, and the seeds take about 9 to 10 months to germinate from time of sowing. The tree at Peradeniya fruited for the first time in 1900, and in 1915 produced 51 fruits.

24. *Clavija ornata* (Myrsinæ): A small and very pretty tree of South America, bearing a crown of leaves of large size and of palm-like habit varying from 18 to 20 in. long, and producing racemes of bright orange coloured waxy flowers which are borne on the axils of the leaves, from the scars of fallen leaves, or on the bare trunk. The root of this tree is sometimes used as an emetic.

25. *Mimusops Kauki* (Sapotaceæ): Native of Burma, Malaya, and introduced into Peradeniya in 1901. A small tree, similar to *M. hexandra*, bearing brownish purple berries, the fruits of which are of an agreeable acid flavour, and used mixed with the roots of Ginger as a cataplasm for tumours.

26. *Cerbera Tanghin* (Apocynaceæ): A small tree, native of Madagascar, the fruits of which contain a poisonous juice used in Madagascar as an ordeal in cases of suspected crime. The fruit is about the size of an almond and is said to be sufficient to poison 20 persons.

27. *Holarrhena antidysenterica* (Apocynaceæ): A small tree of Tropical Asia, known as "Kurchi" or "Conessi bark." The wood is used largely for turnery and furniture. The bark and seeds are bitter and used a great deal in Hindoo medicine, the bark being one of the principal remedies for dysentery. The flowers are white and sweet scented.

28. *Acokanthera spectabilis* (Apocynaceæ): "Arrow Poison." Native of South Africa. A large shrub or small tree bearing masses of white fragrant flowers. The seeds are intensely bitter and the whole plant is considered by the natives of Africa to be deadly poisonous, the root being used for poisoning their arrows.

29. *Arthrophyllum (Phyllarthron) Bojerianum* (Bignoniaceæ): Native of Madagascar and introduced here in 1902. A shrub of peculiar appearance, and rare. The leaves are reduced to winged petioles which are biarticulate, the upper ones elliptical, more or less acute, and the lower ones narrow, cuneate; subcoriaceous, glabrous. The fruits are edible.

30. *Aegiphila martinicensis* (Verbenaceæ): A handsome shrub, native of the Martinique Islands, and introduced into Peradeniya in 1908 from British Guiana. Very similar to Rondeletia, and bears clusters of bright pink flowers. Most useful for ornamental purposes.

31. *Persea Nammu* (Lauraceæ): A small tree native of China and introduced here in 1884. The source of Nammu wood, the latter being extremely hard and durable, and used in China to a large extent for buildings, bridges, furniture, etc.

32. *Cinnamomum Cassia* (Lauraceæ): "Cassia Bark." A medium sized tree, native of Burma and China, and introduced into Peradeniya in 1882; yields the well-known "Cassia buds" used as a spice, chiefly in confectionery.

The bark is often used to adulterate cinnamon. The tree grows fairly well at Peradeniya, but rarely produces seed, and is very difficult to propagate.

33. *Brosimum Aubletii* (Urticaceæ): "Leopard" or "Snake wood." A good timber tree of Peru and Brazil, growing to a height of 60 to 70 ft. The heartwood is extremely hard and well mottled with dark blotches, having a fancied resemblance to the skin of a tiger or snake.

T. H. PARSONS.

AGRICULTURAL RESEARCH IN INDIA.

The report of the Agricultural Research Institute and College, Pusa, for 1914-15 has come to hand and comprises the reports of the Director, Imperial Agriculturist, Agricultural Chemist, Economic Botanists, Mycologist, Entomologist, Pathological Entomologist, Agricultural Bacteriologist, and Cotton Specialist.

The report of the Agricultural Bacteriologist is a valuable one indicating much research work on the subject of bacterio-toxins in soils.

In soils in which æration is incomplete, as a consequence either of want of proper cultivation or of drainage, the decomposition of organic matter by such bacteria as thrive under these conditions will result in the production of toxins inhibitory of nitrification. It has also been shown that these toxins are destroyed by exposure to air and can be removed in water solution, so that the ordinary operations of tillage and drainage can prevent their accumulation.

Work with seedlings has shown that in high concentration, such as occurs in water-logged soils containing much organic matter, these toxins may directly affect growing plants especially seedlings, but this is an exceptional condition, whereas it appears probable that in normal fully ærated soils the toxins resulting from the ordinary metabolic activity of soil bacteria are oxidized at about the same rate as they are produced and no accumulation takes place. A very slight interference with the oxygen supply to the soil, however, will turn the scale in favour of accumulation of toxins and in consequence upset the natural equilibrium existing in the soil complex between the toxin-sensitive nitrifying organisms on the one hand and the apparently less easily affected reducing organisms on the other, thus resulting in indirect injury to the crop by interference with the supply of nitrogen as nitrate. In soil which has been flooded during the monsoon the toxins formed may persist long enough to seriously prejudice the growth of seedlings if planted too soon; such soil should be given as long a period of æration as is possible before planting.

It was found in the case of seedling maize and sorghum grown in soil or sand and watered with extracts of soil made toxic by keeping the latter under semi-anærobic conditions that the residual contents of the seed were

attacked by bacteria which had multiplied as a consequence of the prevalence of such conditions and had been transferred with the toxic extracts; the result of this attack was the production of toxic putrefactive bodies in immediate contact with the seedling resulting in its death; this did not occur in presence of copper sulphate. MR. MILLIGAN, Imperial Agriculturist, who drew my attention to the above-mentioned field result with copper sulphate, has pointed out the significance of this observation in connection with this case, and the importance of its bearing upon the vital question of successfully bringing a field crop through the initial stages of germination and growth especially in heavy soils. Experiments are being carried out to test the value of antiseptics in relation to the early stages of plant growth under varying soil conditions from this point of view.

TRAINING MEN TO CONDUCT RESEARCH.

PROFESSOR J. A. FLEMING, F.R.S.

Whilst the highest achievements in scientific research and invention must always depend to a great extent on that indefinable quality we call genius which cannot be made to order, it can scarcely be doubted that much can be done to foster and assist it.

The nation must be educated to see that the men with high scientific and inventive ability in it, not by any means too numerous, constitute a national asset of inexpressible value. This power, when it exists, should not be allowed to dissipate itself in a struggle to secure the means of living, but be given an opportunity for the fullest exercise and use. There can also be no question that we have it in our power by suitable methods of education to develop such nascent ability.

Our present systems of education, and particularly the system of written examinations which are dependent so much on good memory for success, do much to destroy originality. In spite of all that has been written and said on this subject, we do not seem to be nearer to essential reforms. The object of all education is threefold: first to train character, will, and that power of selecting the best amongst various courses of action which we call right judgment; secondly, to impart necessary information and ability to do certain things well; thirdly, to develop initiative and the power of handling new problems or investigations and a certain alertness in dealing with new situations. Our present methods of education are far too much directed to supplying ready-made and peptonised information.

The great outstanding fact in modern life is the degree to which the energies and materials of nature are employed to overcome the difficulties created by the increase and concentration of population. We have to make the earth bring forth her increase at a greater rate, to supply the ever-increasing necessities of growing populations and the many artificial wants which have been created by progressive human desires. Hence an absolutely essential part of any complete education is some knowledge of science, and especially of its influence on the welfare of mankind. Yet the people we put in a position of authority over us are, for the most part, not only ignorant of science, but not even interested in it. In our public schools we train boys chiefly by directing their attention towards the form of the grammar and literature of two dead languages, and we neglect to give them any wide and sufficient knowledge of things—viz., the physical phenomena of the universe in which they live.

Is it, then, any wonder that when these boys grow up and take their places in Government offices, in the Law Courts or on the Press, or any other influential position, they are oblivious to the last degree of events

taking place in the world of science which have in them the power to make or destroy national industries or affect the living of large populations? The destruction of the madder industry of France and the indigo industry of India by German synthetic chemistry are not old and familiar stories.

The point, however, to notice is that the scientific chemical discoveries were not allowed to remain mere laboratory feats. They were transformed into successful commercial enterprises. The BADISCHE ANILIN UND SODA FABRIK is said to have expended £1,000,000 and taken seventeen years work in translating BAEYER'S scientific synthesis of indigo into a factory process. But the result has justified the foresight of those who expended it. This is only one instance out of many which could be quoted to show the blows that can be inflicted in this industrial warfare, the weapons in which are not shot and shell, but scientific discoveries and inventions.

The supremely important question is: What are the steps we are taking to train the men who will enable us to hold our own in this commercial conflict? It avails nothing to point out that the beginnings of many of these achievements were laid by British scientific discoveries or original suggestions. A truth or a suggestion which is not followed out or pressed to the point at which it becomes practically productive is like a seed which is not planted in the ground. The intellectual perception of a truth or principle requires behind it the driving force of character and will if it is to pass into the useful stage.

Some people might be inclined to ask why there should be this competition and pressure to invent? What difference does it make who discovers a new fact or makes a new application? If scientific knowledge were a mere matter of intellectual curiosity concerning the secrets of nature it would not matter much, except for national honour, who made the discoveries or applications. But scientific knowledge has become much more than this. It has become the means of increasing national wealth, and also by which national wealth can be taken away. Again, in virtue of our patent laws, it has become possible for alien inventors to prevent us from even using in our own country in particular ways the waste products of our own industries as in the case of certain coal-tar products. Hence scientific knowledge can be applied so as to become a tremendous weapon of destruction as well as of national strength. It is for this reason that we require men to be trained, not merely to make scientific discoveries, but to make useful commercial applications of them, which are wealth-producing or wealth-conserving in a national sense. This requires a peculiar combination of scientific ability and commercial insight, and it is just here that Germany has the advantage.

MR. LLOYD GEORGE said on one occasion that he feared Germany's war-bred spirit, by which he meant the willing subjection of a whole empire to discipline. We might say, with even more truth, that what is to be feared is Germany's militant chemistry and engineering, or that combination of commercialised science which is relentlessly applied to undermine and take away sources of power of other nations. This, however, is what we have to meet. We have to train chemists, engineers, electricians, and physicists who are not only learned in the knowledge of their science and originative in discovering new facts and principles, but have also a keen commercial sense which directs them to the solution of the practically useful problems. We have, therefore, to create a very much closer union between industry and science. To some scientific men this seems derogatory to the dignity of science. On the other hand, men concerned with the business side of manufacture are apt to undervalue the aid which science can give them. Meanwhile, our scientific industries suffer from this dissociation.

In the first place we should aim at bringing about a much more intimate relation between the universities and technical colleges and the factories and workshops, so that the college teaching may result in producing a type of

man more useful in the factory. For this reason I am an advocate of the so-called sandwich system, by which the student spends a year alternately in the shop or factory and in the college, the first and third year being at the college and the second and fourth in the shop or factory. This turns out a better type of man than two years at the college and two years in the shop taken consecutively. It should apply not only to engineers in all branches but to chemists as well.

Then, again, conferences should be held from time to time between teachers and practical engineers and chemists for the exchange of ideas on the subject of the schemes of work and study to be followed by the student-apprentice, so as to turn out all-round men and not unpractical theorists or unscientific practists. We have to improve in many ways our college teaching, so as to expend to better advantage the available time, and place more stress on ability to use information than to store it. Engineering and chemical students should be brought much earlier than at present into contact with questions of cost and estimates, so that they may know not only how and why a certain machine works, but what it costs to make it, or to run it. They will then be far better able to take advantage of the workshop training and obtain earlier that "workshop sense" or instinct which looks at everything from the point of view of cost and profit, as well as operation or efficiency.

We have before us a tremendous task to restore the waste of this great war. To do this we have to utilise all waste products and to abolish waste and inefficiency in all departments of life, domestic, commercial, political, and industrial, and we have to get rid of them in scientific work as well. We can only do this by bringing to bear the scientific method upon all these regions of activity and even upon scientific research itself. As a small contribution to this work the above suggestions are tentatively put forward, and with the greatest diffidence I submit them now to your careful consideration.

—NATURE.

NOTES ON LIME-WASHES.

The following notes have been prepared by MR. J. C. F. FRYER, Entomologist to the Board, and MR. G. P. BERRY, General Inspector for Horticulture to the Board.

The insecticidal action of lime-wash when applied to fruit trees has always been a matter of controversy, and this is perhaps natural, for the washes in common use vary within wide limits, not only in their composition, but in the period and manner in which they are applied. The following notes deal only with certain aspects of the problem and are not intended as a discussion on the merits of lime washing in general.

Lime-washes in their simplest form are essentially cover-washes—that is to say, they imprison or impede the movements of insect pests which may be present on the sprayed trees. Frequently, however, their action is more complex owing to the addition of other substances which themselves may have some specific insecticidal action. There is then a difficulty in deciding whether good results are due to the mechanical action of the lime-wash or to the insecticidal powers of the substance added.

In this connection three cases of successful lime washing observed in 1915 are perhaps worthy of mention.

Case I.—A large orchard containing apples was lime-sprayed, while a second orchard, almost adjacent to the first and also containing apples, was left unsprayed. The sprayed orchard was treated with a wash containing 1 cwt. of quicklime to 60 gallons of water with the addition of a certain quantity of commercial lime-sulphur solution.

The work was carried out during April, and the latter applications were made on trees on which the blossom buds had separated and were about to burst. So late was the spraying that some injury might reasonably have been expected, for the trusses in many cases were embedded in a cast of lime. No damage, however, was noted, and the orchard was remarkably free both from apple aphides and apple suckers which were present in abundance in the unsprayed orchard. There is some reason to suppose that the sprayed orchard would in any case have been somewhat cleaner than the unsprayed owing to work carried out the previous year, but the marked difference between the two cannot wholly be attributed to this, and it is believed that the lime washing was in the main responsible.

Case II.—An apple orchard was sprayed during March and April with a "self-boiled" lime-sulphur wash, the ingredients being in the proportions of 1 lb. sulphur, 5 lb. lime, 10 gal. of water.

The last section was not sprayed until the third week in April, when the blossom was in truss and about to open. This section was very free from apple aphides and apple suckers and produced the heaviest crop of apples. Further, it was noted that the foliage remained active unusually late in the autumn.

On the other hand the sections of the orchard which were first sprayed were severely attacked by apple aphides and lost their foliage, which was much injured, comparatively early in the autumn.

Case III.—A damson orchard was sprayed between 10th February and 7th March with a mixture of lime, water-glass and salt (lime 1 cwt., water-glass 5 lb., salt 20 lb., and water 100 gal.)

The orchard was treated in sections which may be indicated as A,B,C,D. On section A there was a severe aphis attack and little fruit was obtained. Sections B and C were less damaged, and the latter produced a fair crop. Section D was sprayed during the week ending 7th March, by which date the condition of the trees was so advanced that injury from the treatment was feared. No damage, however, could subsequently be traced, and section D remained free from aphis attack and produced a very heavy crop.

DISCUSSION.

The above notes were made in commercial orchards which could not be kept under the close supervision possible in an experiment station, and they therefore lack many of the detailed observations which are usually desirable. At the same time in each case there were areas which acted as controls, and it seems permissible to draw certain conclusions.

In the first place, it would appear that an effective control as regards aphides was obtained whenever the trees were sprayed at a very late period—in fact, shortly before the blossom opened. Secondly, this late spraying caused no damage whatever to the foliage and blossom, though previously, from their advanced condition, some injury was anticipated. These conclusions apply equally to the apples and damsons, for the condition of the blossom at the dates of spraying was approximately the same in each case.

Finally, the sprays which produced these results differ materially in composition and need more detailed consideration. That used in Case I contained a very high percentage of lime with the addition of boiled lime-sulphur solution—that is to say, a solution containing various chemical compounds of lime and sulphur, some of which are supposed to have a definite action on certain insects—notably, scale insects. In Case II. a "self-boiled" lime sulphur was used. This wash differs from boiled lime sulphur in that the entire heat required for its manufacture is produced by the lime when it is slaked and no fire is used to prolong the boiling. When made under ideal conditions it is believed that the sulphur is only reduced to a very fine state of division and that little of it enters into chemical

combination with the lime. It differs radically, therefore, from boiled lime-sulphur, in which all the sulphur is combined with lime. In the formula given, however, there is a great excess of lime as compared with more usual formulæ for the preparation of this wash, and it is possible that a considerable proportion of the sulphur may have combined with lime. It would be unwise, therefore, to suggest the final constituents of the wash used, but it is evident that there must have been a great excess of free lime. The wash, however, was evidently "thinner" than those employed in Cases I and III.

In Case III., though the details are a little uncertain, it appears that a thick lime-wash was used with the addition of salt and water-glass. The action of the two latter substances is uncertain, but from some experiments it would appear that the salt may have some insecticidal properties. The water-glass, however, is only supposed to assist the lime in adhering to the trees, a contention with which all will not agree.

Comparing the three different washes which, in spite of their difference in composition, seem to have had much the same result, it appears evident that their insecticidal action must have been due primarily to their mechanical or "covering" properties. It would be unwise to speculate as to whether this action was exerted on the eggs of the aphides or on the newly-emerged insect, but in either case there seems no doubt that the more nearly the time of treatment approaches the hatching period of the insect the less important is the exact composition of the lime-wash and also the greater the chance of success.—JOUR. OF THE BD. OF AGRIC.

AGRICULTURE IN INDIA.

The long-looked for report on agriculture in India by MR. JAMES MACKENNA, I.C.S., has been published. SIR ROBERT CARLYLE, lately member in charge of the Revenue and Agriculture Department, in a foreword writes:—"MR. MACKENNA's book brings out very clearly that although a certain amount of work, spasmodic and intermittent in character, was done before 1905, it is only within the last ten years that scientific agriculture has been seriously taken up in India. Ten years ago LORD CURZON, greatly assisted by SIR EDWARD LAW and SIR DENZIL IBBETSON, organised the department on its present lines, and although a great deal of spade work had to be done an excellent beginning has been made, and results of real value have already within this short period been achieved. The band of zealous workers who labour to benefit the people of India have before them great opportunities, and if the work so well begun be steadily continued an economic revolution should within the next twenty years be effected in this country, especially if the co-operative organization be utilized to the full in making known the results of research and experiment."

MR. MACKENNA in concluding his report writes:—The decade to which this review refers has been marked by an organised and systematic effort to improve the agriculture of India. The labours of earlier years were spasmodic and disconnected, and left little impression on the general agricultural condition of the country. Scientific workers were few. Their work was not co-ordinated and they received little encouragement either from officials or from the cultivators in whose interests they were working. Their efforts were viewed at best with sympathetic toleration or amused unbelief. But all this is now changed. The agricultural departments are now regarded as an integral and important part of the administration. The few European and Indian workers of 1905—158 in all—now number 866. Their labours are concentrated and co-ordinated. They now work on general schemes of development. Farms and demonstration plots, formerly scattered and disconnected, have increased from 35 to 374, and work on them is concentrated

on the main problems, and not dissipated as used to be the case over a number of subsidiary and unimportant enquiries. As a result the department can claim credit for a great advance in general agricultural practice. Cultural and manurial problems have in many cases been solved. Local machines have been improved and adapted, or better implements introduced. Real and substantial work has been done on the improvement of such important crops, as wheat, cotton, rice, sugarcane and tobacco. The general principles of crop improvement have naturally been dealt with first. But given more men and more money all the crops of India will be taken up. Money spent on agriculture is a good investment, but material results are difficult to gauge. Many factors have to be considered. A whole industry threatened by destruction may be saved by the discovery and application of preventive and protective methods. The treatment of the palm industry and arecanut industry of Madras and the protection of the potato crop of Patna are illustrations of this kind. Again, there are the direct gains following the introduction of new or improved crops, implements, well-boring and improved methods of cultivation. We may at a conservative estimate claim that the increase to the value of the agricultural products of India as a result of the labours of its agricultural departments is already about 3½ crores of rupees annually, or over £2,300,000. This is the result of only ten years' work, and it must be remembered that every year will show a progressive increase. On the debit side we have an annual expenditure on agriculture which has risen from Rs. 881,124 or £58,742 in 1904–05 to Rs. 5,130,652 or £342,043 in 1913–14.

ECONOMIC PROGRESS.

But the progress of the past decade has been more than merely material. A mutual understanding and friendship has grown up between the officers of the department and the cultivators. The former have long ago given up the idea that the East has nothing to teach the West. They have found that the only way to real progress is a due appreciation of local conditions and difficulties based on an accurate study of indigenous methods and a sympathetic co-operation with the cultivator: without this they labour in vain. Agricultural development cannot be fostered by compulsion or force. The adoption of the methods recommended is entirely optional. The cultivator need not take them up unless he wants to. He certainly will not do so unless he is convinced that they are better than his own. The days of suspicion and mistrust are, however, gradually passing away, and with the cordial and increasing co-operation of the cultivator an era of real progress has begun. But if we are to influence to any extent the vast agriculture of India some arrangement must be devised to deal with large bodies of cultivators as it is an economy of time to deal with a group of people rather than with single individuals. The physical capacity of members of the agricultural department has its limits as we have seen. The stages of their work are research in the laboratory of the field experiment on a field scale, demonstration on demonstration farms, and multiplication of seed on seed farms for distribution. But it is clear that direct distribution to individual cultivators is much less efficient than distribution to a group of cultivators or a whole village. In the former case control would be difficult if not impossible, and the improvised seed would rapidly disappear. In the latter, the new seed can be concentrated, controlled, and established in a definite area.

CO-OPERATION.

The decade which has witnessed this striking improvement in agriculture has also seen the rapid growth of the co-operative credit movement that great factor in all schemes of economic development. It is a happy omen for India that the two lines of development should have come into prominence simultaneously. By the establishment of the co-operative

movement, the propagandist work of the agricultural department has been immensely simplified. Improvements can be taken at once to a group of cultivators bound together by common interests instead of to isolated individuals, working selfishly. By the provision of credit, improved methods, expensive though they be, have been brought within the reach of the small cultivator, and by co-operation facilities for the more favourable disposal of his produce have also been provided. The small cultivator is lifted out of his narrow and restricted surroundings, and brought into direct touch with outside markets. Co-operation must be the bond between the cultivator and the department, between the cultivator and the market, between the cultivator and the large body of well-to-do Indians whose sympathy and interest, prior to the advent of co-operation, found an outlet in agricultural associations. Co-operation and sympathy must be the driving force all along the line. There must be less talk and more work, and the dignity of labour must be recognized. All are working for a common cause to improve the position of the individual cultivator, and to increase the material wealth of India. The economic and social regeneration of India lies in the co-operative development of her agriculture and her industries.—INDIAN AGRICULTURIST.

THE NEED FOR DESTROYING WEEDS.

Closely connected with the question of pure seeds is that of foul land, and the Board desire to call the special attention of farmers to the great need for combating weeds, which are usually responsible for great loss in the yields of crops. On a properly weeded area the crop may be double that on an unweeded area; e.g., in one case mangolds, grown under otherwise exactly similar conditions on the same field, yielded 37¼ tons per acre where two hoeings were given, and only 16¼ tons where there was no weeding after singling.

Further, a careful estimate has led to the conclusion that the annual loss actually due to the presence of weeds, and to the increased cultivations, etc., necessary to keep them in abeyance, amounts to about 20*s.* per acre in the case of root crops, 10*s.* per acre in the case of cereal, pulse, and other arable crops, 10*s.* on permanent grass, and 5*s.* on rotation grasses, etc., or about 16½ millions sterling per annum.

In this connection it may be remarked that in a Memorandum issued last year by the Farmers' Club it is observed that, "The biggest waste in agriculture is caused by weeds. As a rule, weeds are permitted by bad farmers only, and a determined attempt, notwithstanding all difficulties, should be made to get rid of the weeds so that the yield per acre of the crops we grow may attain the highest standard."

The general means available in normal years for the destruction of weeds are detailed in Leaflet No. 112 *(Weeds and their Suppression)*. In view of the fact that a larger acreage than usual of cereal crops was grown last year, and is likely to be harvested in 1916, special precautions should be taken to prevent weeds getting the upper hand. Apart from mechanical means of destroying weeds usually practised, several points are especially deserving of notice:—

(1) Seeding of all weeds should be prevented by all possible means.

(2) All perennial weeds should be cut down frequently to exhaust the suppliers of food stored up in their roots, and prevent storage of further supplies.

(3) An endeavour should be made to prevent weed seeds separated out in the course of threshing and winnowing and the refuse seeds from haylofts from again reaching the fields. Wherever possible these should be burnt.

Farmyard manure, believed to contain weed seeds in any quantity, should be allowed to rot well before application to the land. Many weed seeds may be present when meadow hay and chaff (barren glumes) of oats are fed to stock.

(4) In certain cases, where hand-hoeing is largely practised, corn crops may usefully be drilled in rows wide enough apart to permit of horse-hoeing, say 8 in. to 9 in. apart. This is especially useful in the case of spring-sown corn.

(5) Where horse-hoeing cannot be practised, the wetter the climate, or the more the land is subject to the growth of annual weeds, the closer the drill coulters should be set. When weeds are plentiful it is advisable immediately after harvest to disc or lightly scarify the surface, with a view to encouraging the germination of annual weeds. These should afterwards be ploughed down.

(6) Where weeds are likely to be abundant it may also prove a good plan to sow part of the root "break" with a vetch mixture in autumn. This would not only "smother" out weeds but reduce the labour bill for roots.

Under the Norfolk four-course rotation the area devoted to roots imposes a severe strain on labour, even in normal times. At the present time, all indications point to the necessity for modifying the usual practice. It is well known that success in root-growing and the welfare of the crops that follow depend largely on careful, thorough, and persistent cultivation of the root "break." It is desirable, therefore, that farmers should adopt every practicable means of suppressing weeds at all stages of the rotation, as for example, by the growth of heavy corn crops, and they should include in the root area such crops as will suppress weeds, save labour, and provide suitable supplementary keep for stock in winter.

LABOUR.

During the past year, no doubt largely owing to shortage of labour, weeds were unusually plentiful in many districts.

The shortage in manual labour may largely be met in so far as the destruction of weed is concerned by the employment of women and children, working when necessary in gangs in charge of one or two older and practised hands; and of temporary workers who may be in a position to do work of this kind for short periods.—JOUR. OF THE BD. OF AGRIC.

ERADICATION OF FERNS FROM PASTURE LANDS.

H. R. COX.

Over 200 species of ferns are known to be native to the United States; only two of these have become serious weed pests, viz, the hay-scented fern (*Dennstaedtia punctilobula*) and the brake (*Pteris aquilina.*)

Several other species are sometimes annoying, but they occur largely in low and moist places and do not give much trouble on good pasture land. They are principally the cinnamon fern (*Osmunda cinnamomea*), the marsh fern (*Orthopteris thelypteris*), and the sensitive fern (*Onoclea sensibilis*). The two first species are troublesome in the hill country of the North-eastern States and the higher mountain country further south. On the Pacific coast the chief fern weed is *Pteris aquilina*.

This bulletin deals with the fern problem of the Eastern States. Although the experiments here recorded were made with *Dennstaedtia punctilobula*,

there is no doubt that the treatment found most effective with that species would apply equally well to *Pteris aquilina*. Both kinds are perennials, with running root stocks more or less parallel to the soil surface.

In most parts of the East where the ferns are weeds the land is so steep and rocky that cultivation is not practicable. It has been found that the cutting off of the tops close to the soil surface twice a year for two years will kill out nearly all of the ferns. The best times to do cutting are just previous to spring, or about the middle of June, and the middle of August in southern New York

Experiments were made in 1912 and 1913 to test the efficacy of spraying as compared with cutting and to learn the best methods of obtaining a stand of grass and clover on the fern-infested area. The spray materials used were solutions of salt, arsenite of soda and iron sulphate. These substances were used in quantities of equal value.

Of these three compounds, salt proved to be the best. The iron sulphate was ineffective; arsenite of soda was effective, but from its poisonous character, its use involved some risk to men and animals; further, except in the large centres it is difficult to obtain. The quantity of salt required to the acre depends on the thickness of the fern; 200 lb. per acre is usually ample, 1 lb. of salt being used to about 1½ quarts of water. A man with a knapsack sprayer ought to cover about 5 acres a day. The cost of spraying with salt is $1·05 per acre for each application, not including the cost of hauling the materials. Three sprayings a year seem to be about as effective as four, and are to be recommended.

Cutting the ferns is usually a cheaper method than spraying (a man cuts about 2½ acres a day and the labour is the only expense incurred); further a good growth of young grass and clover may be obtained, which contributes to the reduction of the subsequent development of the number of ferns. Cutting is therefore to be recommended in preference to spraying in most situations, but if the land is very stony, spraying may be the best method. It was found that scattering seed on the patches where ferns had grown was the most important means of getting a stand of grass and clover, and that liming and fertilising in addition to seeding were of considerable benefit.

—BULL INT. INST. OF AGRIC.

LUCERNE IN DELAWARE.

A. E. GRANTHAM.

This bulletin (Delaware Stn. Bull. 110) briefly discusses methods of production and the value of the crop for various purposes, suggests suitable rotations, and gives results of fertilizer experiments with alfalfa.

The data show that higher yields of hay followed the use of 2,000 lb. of burnt lime per acre than of either 1,000 or 4,000 lb., and that when acid phosphate was used singly or in combination with other fertilizers the increase from the use of lime was not so great as where phosphoric acid was not applied. "The plats receiving nitrogen alone and nitrogen and potash were a trifle less favourably located, and while the stand of alfalfa was good, the yield is perhaps a little less than it should be. Thus nitrogen alone produced a little less than the uninoculated check; nitrogen and potash without lime yielded about the same as the check. The low yields from these plats might be considered in error if it were not for the poor showing nitrogen and potash made in other combinations. Where nitrogen was used in connection with phosphoric acid and potash and not limed, the gain due nitrogen was zero,

Where the above combinations were used with lime, the gain due nitrogen was but 40 lb. Where nitrogen was used with phosphoric acid and unlimed, as against phosphoric acid alone, the gain due nitrogen was but 130 lb. Potash behaves similarly to nitrogen, although the gain is more than from nitrogen. Where potash is used with nitrogen combined, as compared with nitrogen alone, the gain due potash is only 120 lb. The combination of phosphoric acid and potash unlimed, as compared with phosphoric acid alone, gives an increase of 400 lb. due to potash. Where nitrogen, phosphoric acid, and potash were used together and unlimed, as compared with nitrogen and phosphoric acid, the gain due potash is 270 lb. If lime is added to both of the above combinations, the increase from potash is 560 lb.

"Phosphoric acid and lime seem to be most effective in increasing the yield . . . In the combination of nitrogen and phosphoric acid, unlimed, phosphoric acid gives a gain of 1,930 lb. over nitrogen alone. With nitrogen and potash, phosphoric acid, unlimed, gives an increase of 2,080 lb. over nitrogen and potash alone; when lime is added to both of the above combinations the increase due to phosphoric acid is 1,000 lb.

"Lime shows a marked effect in every case, except. . . .when phosphoric acid and manure were used. Phosphoric acid used with and without lime gave a difference in favour of lime of 380 lb. per acre. Where lime was used with nitrogen as against nitrogen alone the gain due lime was 1,920 lb. The effect of phosphoric acid is seen in the combination of nitrogen and phosphoric acid as against this with lime. Here the lime made an increase of only 350 lb. per acre. Nitrogen and potash combined, with and without lime, gave an increase of 1,720 lb. due to lime. Where nitrogen and phosphoric acid were combined as against nitrogen, phosphoric acid, and lime the latter combination gave an increase of only 600 lb. On the plat where all three elements were combined with and without lime the lime made an increase in yield of 640 lb.

"Wh re manure was applied lime made a very small increase in yield of hay per acre. In combination with 5 tons of manure lime made an increase of 140 lb. per acre; with 10 tons of manure 280 lb. increase was made. The reason for lime failing to show much effect is probably due to the fact that manure is often alkaline in reaction, thus supplanting the lime in sweetening the soil, or, if the soil lacks sufficient lime as direct plant food for the alfalfa, the soluble lime in the manure may take the place of the applied lime, thus accounting for the poor showing of the commercial lime.

"Inoculation gave an increase in the yield of hay of 1,360 lb. over no treatment."

The results of co-operative experiments with farmers throughout the State were similar to those secured in the station fields.—EXPT. STN. REC.

VISIT TO A JAFFNA FARM.

The term "farm" as used in S. India and North Ceylon signifies a plantation of mixed crops consisting chiefly of annuals, and cultivated in a systematic manner as regards the relation of the crops to each other and also as regards tillage and fertilising.

Of this character is the farm owned by MUDALIYAR MUTTU WELLOPILLAI at Vallygamam North and called "Intanai" about 5 miles from Jaffna, which the writer had the pleasure of visiting on the first of March last.

The entire area is 100 acres in extent and is divided by the railway line to Kankesanturai into two equal parts.

Irrigation of the cultivated area is carried out by means of two six-inch tubular pumps driven by an oil engine. With the exception of the engine the entire plant has been designed and constructed by MR. MUTTUWELLOPILLAI himself, the water being raised from a large well. By this means from 9 to 10 thousand gallons of water are brought up per hour for which only 3½ to 4 Brake Horse Power is required for a head of 25 feet.

The area under tobacco is about 12 acres, another 30 acres being under plantains, manioc and chillies, while other crops raised include Kurakkan (*Eleusine coracana*), Sami (*Panicum miliare*), gingelly (*Sesamum indicum*) and green gram (*Phaseolus radiatus*). There are also about 30 acres reserved as pasture ground while a small area is under fodder crops. Ten acres have lately been planted with coconuts cultivated on red soil under irrigation.

Chewing tobacco of excellent quality is raised on the land and 1000 leaves of average size fetch from Rs. 60 to Rs. 100.

The common measure of land is the lacham. A lacham of tobacco or garden land is equivalent to 1/16 of an acre, but in the case of paddy land only 1/24 acre. It is usually reckoned that an acre carries 4,000 tobacco plants, and the best land (such as is found at "Iritanai") can be leased for as high as Rs. 80 per annum. The standing crop will fetch as much as five or six hundred rupees per acre.

Green manuring is carried on by the application of green stuff brought on to the land. For such leguminous material Rs. 12 to Rs. 20 or more per cart load is given and the manuring of an acre of tobacco may cost Rs. 200 or more. One of the most popular and expensive leguminous manures is *Tephrosia purpurea*. People who have waste lands producing weeds suitable for manuring can get Rs. 30 or more per acre for their produce.

Plantains or Bananas can be seen growing to perfection. No more than 3 plants are allowed to each bush and 300 to 400 bushes (according to variety) go to the acre. The varieties used as fruit fetch 50 to 75 cents a bunch, but "ash" or curry plantains up to Rs. 1·25. The former are taken off the trees as soon as they are mature but while still of a green colour. A number of bunches are placed in a hole dug in the ground, overlaid with twigs and covered with soil, and smoke generated in a vessel containing dry plantain leaves and straw is blown into the hole. After two days they are taken out and are dipped in water and almost immediately the fruits turn an ivory yellow colour.

Coconuts under irrigation are doing very well.

A visit to this farm is both interesting and instructive and well worth the time expended on it. The lesson which MR. MUTTUWELLOPILLAI is teaching of industrious and intelligent cultivation, producing as it is bound to do successful results, is one which deserves close study by those who have land to cultivate. His enterprise in setting up an irrigation plant, which secures for him the maximum benefit at the minimum cost, is worthy of the highest commendation.

C. D.

One of the most striking items provided by an investigation of soil gases dealt with in the memoirs of the Department of Agriculture in India (Chemical Series, Vol. iv. No. 3) is the composition of gases in the neighbourhood of the roots of plants. The proportions of carbon dioxide found are high; but most striking of all is the low proportion of oxygen, and the presence of hydrogen, which has not hitherto been suspected under these conditions. It is stated that the diffusion of gases through soils at a depth of 12 to 15 inches is so efficient as to warrant the conclusion that cultivation of the surface soil is unnecessary for purposes of æration.—AGRICULTURAL NEWS.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Soccotrine cwt.	Fair to fine	70/ a 80/
Zanzibar & Hepatic ,,	Common to good	40/ a 75/
ARROWROOT (Natal) lb.	Fair to fine	3½d a 4d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£6 17/6 a £7 2/6
East Indian, bleached ,,	Fair to good	£8 12/6 a £8 15/
,, unbleached ,,	Dark to good genuine	£6 a £6 10/
Madagascar ,,	Dark to good palish	£6 10/ a £7 2/6
CAMPHOR, Japan lb.	Refined	1/7½ a 2/
China cwt.	Fair average quality	155/ nom.
CARDAMOMS, Tuticorin	Good to fine bold	3/6 a 4/6
per lb.	Middling lean	2/ a 2/9
Malabar, Tellicherry ,,	Good to fine bold	3/6 a 4/6
Calicut ,,	Brownish	2/ a 3/
Mangalore ,,	Med Brown to good bold	3/ a 5/3
Ceylon, Mysore ,,	Small fair to fine plump	1/9 a 5/9
Malabar ,,	Fair to good	1/7 a 1/8
Seeds, E. I. & Ceylon ,,	Fair to good	1/9 a 1/10
Ceylon "Long Wild" ,,	Shelly to good	1/ a 1/6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	110/ a 120/
Japan ,,	Fair bright small	110/ a 120/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜d a 7d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts.	Fair to fine quill	1/1 a 1/9
per lb. 2nds.	,, ,,	1 a 1/6
3rds.	,, ,,	11d a 1/4
4ths.	,, ,,	10d a 1/1
Chips.	Fair to fine bold	2⅜d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	11d a 1/2
Amboyna ,,	Dull to fine	10½d a 11d
Zanzibar ,,	Fair and fine bright	7½d a 8d
Madagascar ,,	Fair	8d
Stems ,,	Fair	2¼d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	,,
COCOA, Ceylon Plant. ,,	Special Marks	87/ a 92/6
	Red to good	80/ a 86
Native Estate ,,	Ordinary to red	57/ a 87/
Java and Celebes ,,	Small to good red	70/6 a 98
COLOMBO ROOT ,,	Middling to good	35/ a 40/
CROTON SEEDS, sifted,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	150/ a 170/
GINGER, Bengal, rough ,,	Fair	35/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	50/ a 70/
Cochin, Rough ,,	Common to fine bold	40/ a 47/6
	Small and D's	40/
Japan	Unsplit	40/
GUM AMMONIACUM ,,	Ord. Blocky to fair clean	60/s a 85s
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
	,, ,, red	£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	45/ a 55/ nom.
Turkey sorts ,,	... ...	65/ a 72/6
Ghatti ,,	Sorts to fine pale	17/ a 27/
Kurrachee ,,	Reddish to good pale	22/6 a 32/6 nom.
Madras ,,	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£7 a £9
	com. stony to good block	60s a £6
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	50/ a 60/
Somali ,,	,, ,,	40s a 50s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	32s 6d a 40s
pickings ,,	Low to good pale	17/6 a 30/
siftings ,,	Slightly foul to fine	20s a 30s
INDIA RUBBER lb.	Fine Para smoked sheets	2/11¾
Ceylon, Straits, ,,	Crepe ordinary to fine	3/1½
Malay Straits, etc. ,,	Fine Block	2/4¼
	Scrap fair to fine	2/7
Assam ,,	Plantation	2/3
Rangoon ,,	Fair 11 to ord. red No. 1.	2/1
	,, ,, ,,	2/1

	QUALITY.	Quotations
INDIA RUBBER lb.		
Borneo ,,	Common to good	2/
Java ,,	Good to fine red	2/2
Penang ,,	Low white to prime red	1/11 a 2/
Mozambique ,,	Fair to fine red ball	2/9
,,	Sausage, fair to good	2/8
Nyassaland ,,	Fair to fine ball	2/7
Madagascar ,,	Fr. to fine pinky & white	2/1
,,	Majunga & blk coated	1/10
,,	Niggers, low to good	1/2 a 1/7
New Guinea ,,	Ordinary to fine ball	2/3 a 2/6
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	14/6 a 15/6
,,	Consuming mid. to gd.	13/6 a 14/6
	Ordinary to middling	12/6 a 13/6
,,	Mid. to good Kurpah	8/9 a 11/
,,	Low to ordinary	6/6 a 8/6
,,	Mid. to fine Madras	4/6 a 6/
MACE, Bombay & Penang per lb.	Pale reddish to fine	2/2
	Ordinary to fair	2/ a 2/1
Java	,, ,, good pale	2/ a 2/2
Bombay	Wild	5d
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	1/10 a 2
	80's	1/7
	110's	1/
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20
NUX VOMICA, Cochin	Ordinary to good	24/ a 26/
per cwt. Bengal	,, ,,	22/ a 23/
Madras	,, ,,	23/ a 24/
OIL OF ANISEED lb.	Fair merchantable	3/6
CASSIA ,,	According to analysis	4/ a 4/3
LEMONGRASS oz.	Good flavour & colour	1⅜d
NUTMEG ,,	Dingy to white	1½d a 1¾d
CINNAMON ,,	Ordinary to fair sweet	5½d a 1s 6d
CITRONELLE lb.	Bright & good flavour	2/
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	8½d
Ceylon ,, ,,	Fair to fine bold heavy	8¼d
Singapore ...	Fair	8⅛d
Acheen & W. C. Penang	Dull to fine	nom.
(White) Singapore ,,	Fair to fine	10½d
Siam ,,	Fair	10d
Penang ,,	Fair	10d
Muntok ,,	Fair	10¾d
RHUBARB, Shenzi ,,	Ordinary to good	2/3 a 3/6
Canton ,,	Ordinary to good	1/6 a 2/6
High Dried,,	Fair to fine flat	1/2 a 1/4
	Dark to fair round	8d a 8¼d
SAGO, PEARL, large--cwt	Fair to fine	24/6 a 25/
medium ...	,, ,,	24/6 a 25/
small ...	,, ,,	22/ a 23/
Flour ...	Good pinky to white	18/ a 19/
SEEDLAC cwt.	Ordinary to gd. soluble	55/ a 90/
SENNA, Tinnevelly lb.	Good to fine bold green	11d a 1/
	Fair greenish	9d a 10d
	Common specky & small	7¾d a 8d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	50/ a £5 10/
Bombay ,,	,, ,,	60/ a £5 10
Mergui ,,	Chicken to bold	£6 10 a £12
Manilla ,,	Fair to good	£6 10/ a 10 10
Banda ,,	Sorts	30/
Green Snail ,,	Small to large	55/ a 75
Japan Ear ,,	Trimmed selected small to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	25/ a 27
per cwt. Madras	Inferior to good	Nominal.
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	10/ a 25/
	Pickings	5/ a 15/
TURMERIC, Bengal cwt.	Fair	40/
Madras ,,	Finger fair to fine bold	40/ a 45/
Do. ,,	Bulbs ,, ,, [bright	23/
Cochin ,,	Finger fair	37/6
	Bulbs ,,	22/6
VANILLOES— lb.		
Mauritius ... 1sts.	Gd. crystallized 3½a 8½ in.	7/ a 12/
Madagascar ... 2nds.	Foxy & reddish 3½a ,,	6/6 a 7/6
Seychelles ... 3rds.	Lean and inferior	5/6 a 6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares, cwt.	Good white hard	72/6